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ELECTRICAL WORLD

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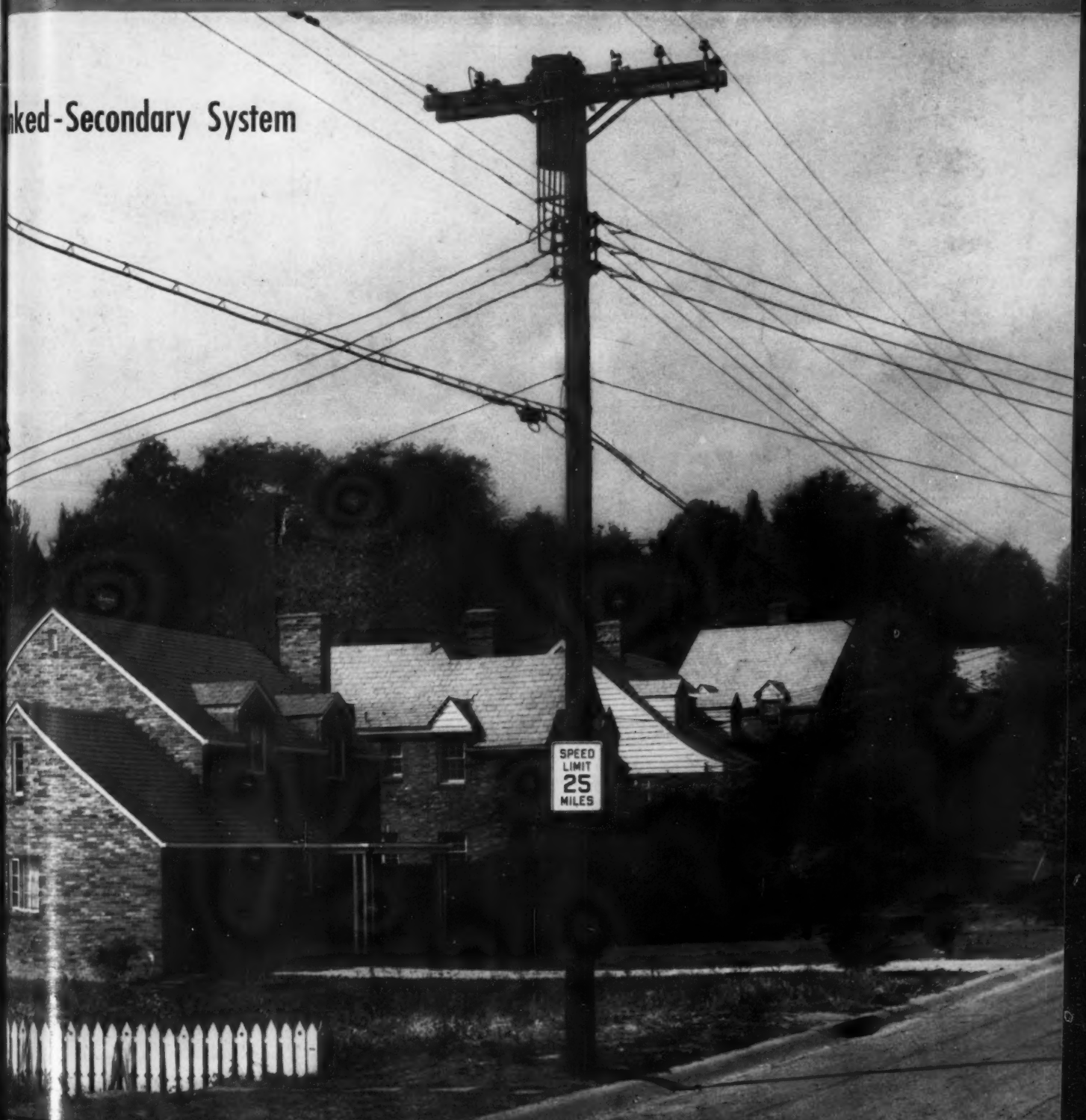

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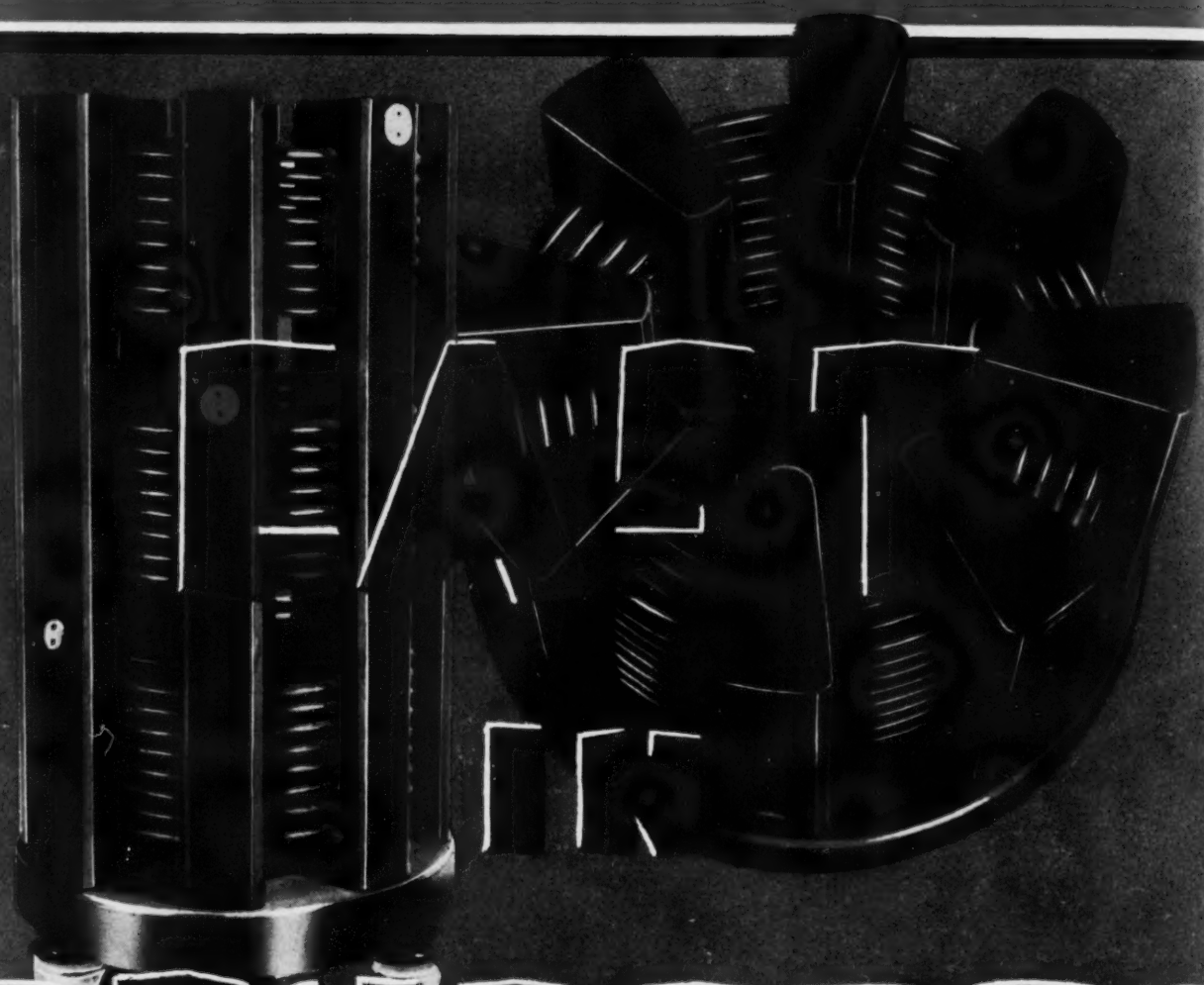

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ELECTRICAL WORLD

Published for 74 years for those engaged in the business of generating, transmitting, distributing or applying electric power

October 23, 1948 **CONTENTS** Vol. 130 No. 17

This Week's Cover Picture

Banked-secondary distribution systems offer advantages for most residential sections and some heavily-loaded rural areas. Benefits include improved reliability, better average voltage, reduced lamp flicker, and more effective use of transformer and secondary-main capacity. See page 81. Westinghouse photo

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COMING IN THE NOVEMBER 6 ISSUE

Locating Cable and Transmission Line Faults
Technique of System Load Allocation
Present Trends in Turbogenerator Design

overcoming an underwater problem for the Northern Pacific

▶ Spanning the St. Louis River, linking Duluth, Minn. to Superior, Wisconsin, swing bridges are operated by the Northern Pacific Railway, "Main Street of the Northwest." Heavy traffic depends upon their smooth electrical opening and closing. For these conditions the railroad wanted a submarine power cable of exceptionally long-lasting service life.

The choice was an Okonite submarine cable. The installation called for 3600 feet of 3-conductor cable. Conductors: Okoloy-coated for corrosion resistance, Semicon-taped to prevent internal corona cutting. Insulation: long-lived Okolite. Armor: Galvanized steel armor wire. O. D. of cable: 2.390". Weight: 5 lbs. per foot.

While moisture-resistance is, of course, an essential, perhaps the most important single factor in this cable's selection is the consistently stable electrical characteristics of Okolite high-voltage insulation even when submerged without an outer lead sheath.

Utilities, carriers, industrial plants use many kinds of Okonite cables — for wet locations, for hot spots, for extreme flexibility, for indoor and outdoor use above or below ground including direct burial. Write for Bulletin EW-1036. The Okonite Company, Passaic, N. J.

6879

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

THE BEST CABLE IS YOUR BEST POLICY

Dewey on Socialism

In his Phoenix, Ariz., speech, GOP Candidate Dewey discussed atomic energy control in words —and under circumstances—which led to a rather broad outcry. The most common charge was that Dewey would make the atom a source of private profit. There were overtones, as well, that the proposal would violate world safety.

Now we are told that Dewey intends to repeat his atom views during this campaign. His object, one learns, is to clarify the point. That point, as we get it, is that atomic energy's potentialities are so vast that one day it can be the chief source of energy for our economy. If today's tight controls, stipulated by the McMahon Act, be continued, we may awaken one day to find our economy a socialized one. So Dewey feels that the die is being cast today which, years hence, can make the U. S. economy a socialized one. It's a prospect he doesn't cherish and he's voting against it now—before it happens.

This is a view we find both pleasing and encouraging. Electrical World pointed out long since and on several occasions that new rules—which may one day be of life or death consequence to the privately-owned electric power industry—were written when the McMahon Act became law. We noted that the industry had to make its limited presentation as to the merit of these new rules without very much significant information on the subject. We continue to note that these rules will have to be interpreted, and that these interpretations themselves may end private ownership of power. We continue to urge that electric companies prepare themselves so that the industry will have a chance to win.

What Dewey fears from the McMahon Act is happening here—today—in the power business, almost completely the result of legislation passed years ago. For one example, there's the Reclamation Act. This 1902 statute first posed the concept of the preferential sale of federally-generated energy. Nobody cared much, in those days, the state of the art being what it was. But today, preferential marketing is as murderous a club as is available to be swung at private ownership of electric power. Incoming federal capacity will demonstrate this.

Now if what Mr Dewey doesn't like is a socialized state, he's got to be against socializing influences wherever they arise, not just atomic socializers. He's got to be against preferential-marketing socializers, and tax-free socializers, and phoney-allocation socializers, and one-way-street-regulation socializers, and interest-free capital socializers. To be against these things he doesn't have to let private systems sell 3 mill kilowatt-hours for 10 cents and he doesn't have to let utility balance sheets contain nonsensical items. He doesn't have to take the government out of the generating business or resource development. He doesn't even have to bow to a power lobby. He has merely to recognize that laws are on the books today which CAN make the socialization of electric power a matter of course within a matter of years. Socialization is what Dewey doesn't like about existing atomic law, and that's just what the power business doesn't like about existing power law. If ultimate socialism be Dewey's target, then the power laws need as much revision as McMahon's masterpiece ever did and it can't happen too soon.

Throttling Rings to Lend?

TO LOSE a whole stage of blading in a turbine is not an uncommon occurrence despite all the design efforts and resort to strainers. When it happens the turbine has often been out of service for months until new blading could be obtained and installed. In certain instances it has been possible and practicable to operate at considerably reduced capacity after just clearing away the debris.

But it is not necessary to sacrifice half or more of the capability of the machine. The loss can be avoided if the wide-open space of the missing blades is replaced by an aperture that will throttle the steam to some degree of conformity with what it is for the ensuing stage in normal operation. Use of just such a throttling ring is related on another page of this issue. It provided 5 months' use of 12,500 kw of the unit's capability otherwise unattainable.

In this instance the ring was machined in a hurry and slipped into the same groove as the removed blade ring. The query arises—why should not the manufacturer keep a small stock of assorted rings on hand to fit his standard or most prevalent reaction machines? Ability to borrow one of these would go far in brushing away the tears that naturally well up into the eyes of the operator thinking, in these times, of incapacitated capacity.

Your Neighbor, the Atom

"ANY LARGE INDUSTRIAL CONCERN that hopes to be in business twenty-five years from now should know what this new weapon, this new physical phenomenon, this new source of energy, this new tool, can do to it and for it."

The words are those of Chancellor Robert M. Hutchins, of the University of Chicago. They concern atomic energy, a subject in which Hutchins is neither unacquainted nor uninterested. They were addressed to a convention of the Controllers Institute of America. Dr. Hutchins made it ever so plain that they were addressed to ANY company, not merely those which can see a direct application of nuclear science to their business right now.

Well, if there be any merit to Hutchins' advice, then the electric power industry certainly is one of those industries which should act upon it. Judging by the volume of 30-year bond issues it has been selling, this industry expects to be doing business a quarter of a century hence. And judging by the limited and disputed atomic knowledge which is accorded the layman these days, the power business will be one directly concerned by atomic energy and nuclear science.

The Chicago-Northern Illinois systems got on the bandwagon a few months ago through their support of the University of Chicago atomic research program. Detroit Edison and Consolidated Edison seem to have more than an idle interest in the subject. Presumably, Association of Edison Illuminating Companies members are at least generally in touch with the atom, for AEIC carried the industry ball during the McMahon Act hearings. Where does the rest of the industry stand? That's a good question. It is to be hoped that the industry is doing enough that it will not have to default when the major atomic power decisions which are ahead must be made.

Georgia Power vs. Government

ONE WAY by which the private electric utility industry and government can live together in perhaps an uneasy relationship is illustrated by the recent contract for disposal of power from Allatoona Dam in Georgia.

Except for the substantial priority for power to public bodies, the contract between the Georgia Power Co and government, via the Interior Department, appears to be a sound and practical agreement. All those in the Industry in a similar position, and eventually most may be, should study this contract with care.

The Allatoona project is a multi-purpose reservoir project for flood control, stream regulation, navigation and power. But by the terms of the agreement, operation of the power plant is under control of the power company, to wit:

"The company will schedule the operation of the power plant . . . in such a way as to make the most effective use of the available equipment and reservoir storage capacity . . . "

This control is limited only by the requirement that the reservoir rule curves and accompanying instructions must be acceptable to Corps of Engineers.

Quoting further:

"The company designates . . . as being the peak period . . ." and "The company shall have the right to change the peak period hours from time to time . . . by giving the government notice . . ."

Thus, the Georgia company maintains certain essential rights necessary to satisfactory operation with its own system.

We also find that the rates for power appear to be reasonable. For the first 36,000 kw unit, the demand charge is $32,500 per month when one such unit is available (90 cents per kilowatt-month) and $42,500 per month when 72,000 kw are available. Energy is sold at 3.5 mills during a 100-hour utility peak period and 2 mills during off-peak periods.

So here we find an apparently reasonable contract, except for the important provision that:

"There is reserved to the government the right to use Allatoona energy for firm power service to facilities owned by the federal government, public bodies and cooperatives, up to a maximum amount of energy in any calendar week of 2,500,000 kwhr."

This reserved energy may often be the maximum available in any one week. Further, this same energy could be delivered directly by the Georgia company to these government bodies at its own reasonable rates. That is the right way, the equitable way for private industry and government to make best use of our country's resources.

NEWS OF THE ELECTRICAL WORLD

The Electrical Week

With demands for electricity growing—an output record of 5,482,030,000 kwhr was set last week—capacity is the pressing need for the coming months. EEI reports 1948-53 expansion programs of 26,166,547 kw and FPC has supplied data on what happened last December as an indication of what may happen in a few weeks . . . Utilities whose employees are in the UWU can look forward to bargaining on pension plans when their present contracts expire. The union so decided at its convention . . . At French Lick, the Indiana Electric Association put aside present problems to concentrate on the future results desired . . . EEI's Equipment Committee at Pittsburgh attributed station starting-up mishaps to the haste in getting the units on the line . . . Distribution advances and design came in for critical study as EEI's T&D Committee met at Swampscott, Mass. . . . And concluding a week that was crammed with meetings, PEA's Relay Subcommittee at Reading was surprised to learn of the infrequency of damage to generators resulting from the loss of field excitation . . . Five Western states have finally agreed on how to divide the waters of the Upper Colorado River Basin, but state legislatures and Congress must still approve . . . And our northern neighbor, Canada, is rather gloomy as primary consumption jumps 10.3% while output is 1.2% less.

Sales of radio tubes are continuing at a terrific pace. So far this year members of the Radio Manufacturers Association report sale of close to 126,400,000 tubes in the first eight months of the year.

Consolidated Edison Co of New York estimates that over 90,000 of its customers have television sets. At the beginning of 1947, the total was less than 10,000.

Look for increased use of "punch-card" checks by utilities for payrolls and dividend payments. The checks, popularized by the government during the war, have many advantages including the important one of economy.

Russia is second only to the United States in production of electricity. The Soviet reported a 1947 production of 54,000,000,000 kwhr.

Rural Electrification Administration fears a Congressional blitz next year on its authority to make generating and transmission loans. It feels the recent blast by Minnesota co-op, municipal, and private power officials against generating co-ops is the opening gun in a drive to stop G&T loans.

A new mineral, named sengierite, has been discovered in the Belgian Congo. It contains 60% uranium, with the remainder about equally divided between vanadium and copper.

The Jewelry Industry Council is considering a survey of jewelry stores to find out the volume of their small electric appliance business.

Off and on, some British scientists have been assuring the world that atomic-electric power would come first in England. But recently, Sir Henry Tizard told the British Association for the Advancement of Science that atomic power can't bring as much benefit to England within 20 years as could be had from practical application of known methods of economizing coal. Sir Henry is chief scientific adviser to the British government.

Rural Electrification Administration held up Sho-Me Power Corporation's contract with Southwestern Power Administration for 50,000 kw of Bull Shoals energy. The contract hinged on approval of an REA loan for transmission lines to Bull Shoals. REA, inclined to grant the loan, decided to talk power supply with utility companies in the area first.

Notes From The News

Copper producing and importing firms have rejected a voluntary-agreements program to make copper available to the government for stockpiling. Executives of the industry have advised Secretary of Commerce Sawyer to get supplies by negotiating with companies individually . . . Kentucky Utilities Co is seeking PSC permission to include a fuel clause in its commercial and industrial rates . . . Louisville Gas & Electric Co will get its natural gas more cheaply as a result of an FPC order to the Kentucky West Virginia Gas Co to cut its rates. LG&E will save about $142,821 annually . . . General Electric Education Committee is accepting applications for research grants for the

1949-50 school year. . . . Arkansas Power & Light Co has received FCC approval to install a two-way FM radio system for service and maintenance crews in its Western Division.

The South Island of New Zealand may become another great aluminum refining center. Aluminum, Ltd, the British-Canadian concern, is considering the island for a new plant because of its potential hydroelectric resources . . . Danville, Va., municipal system is having a water but not a power shortage. Its main storage reservoir is less than 20% full, but Appalachian Electric Power Co is supplying the municipal with all the electricity it needs . . . Seattle City Light is having a color motion picture made to emphasize its contributions to the Northwest Power Pool.

Over 12,000 freight cars of cement will be required for the Hungry Horse Dam. The project will also require about 10,000,000 board feet of lumber . . . A General Electric weather scientist has suggested that dry ice be used to put an end to lightning, or at least that part that causes forest fires. Dry ice would be used to transfer cumulus clouds into snow or rain or into cirrus clouds, which do not produce lightning . . . Britons can look forward without pleasure to another unpleasant winter. A compulsory 20% cut in electricity has been announced, with the commercial customer, as usual, suffering the most severely . . . Kennewick, Wash., is planning to buy the water system serving the city from the Pacific Power & Light Co.

Puerto Rico has a lot of American ideas; one of them is to use more electricity. Production during the first half of the year was 225 million kwhr, compared with 196 million in the corresponding period of 1947 . . . South Carolina Public Service Authority is still in the fight to secure control of the South Carolina Power Co. In a Federal Court suit, the Authority is seeking to have the court order the FPC and SEC to set aside their approval of the sale of South Carolina Power stock by Commonwealth & Southern Corp to the South Carolina Electric & Gas Co . . . The American Wood-Preservers' Association now boasts of 1,231 members, largest number in its 44-year history.

CONSTRUCTION:

New York State Electric & Gas Corp broke ground Oct 12 for an addition to its Jennison Station at Bainbridge. Another 33,000-kw unit is to be added. The company's 35,000-kw Hickling Station at East Corning is being prepared for a test run . . . Calgary Power, Ltd, is planning construction of a dam and a 10,000-hp hydro plant at Bearspaw on the Bow River . . . The street lighting program of Richmond, Va., is being delayed because street lights are mounted on poles of the Virginia Electric & Power Co or of a telephone company. The two utilities have been too busy to install their poles just where the city wants them . . . Georgia Power Co will build an 18-mi, 110-kv transmission line into Dalton. The other terminus will tie in with the TVA system at Ooltewah, Tenn.

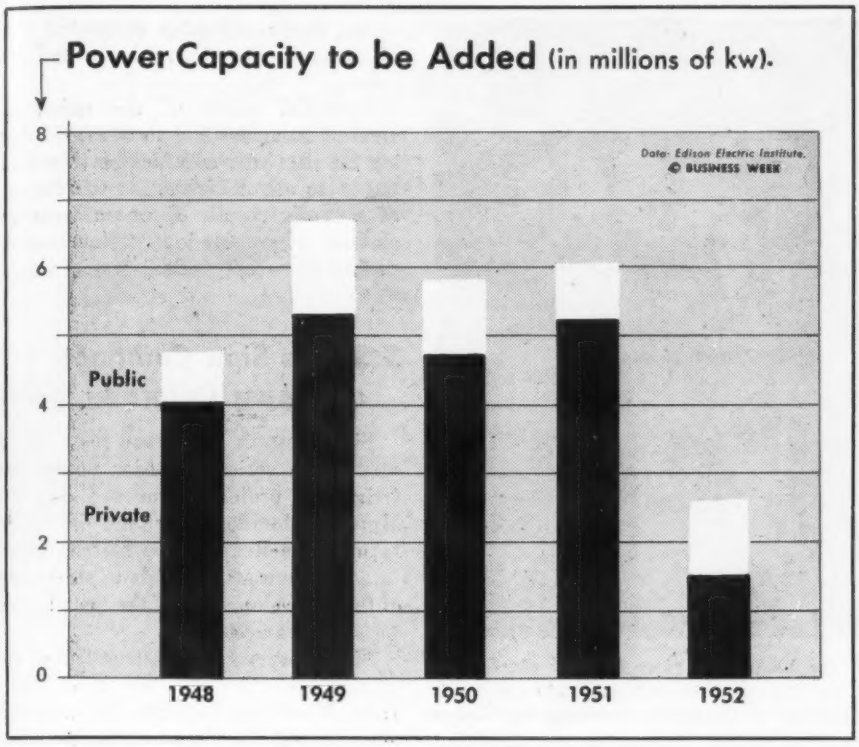
BURIED ten feet under a cement-surfaced alley for at least 38 years, this GE carbon-filament type lamp made by General Electric Co in 1905 for use in signs will still burn. O. P. Anderson of Nela Park examines the lamp which was one of ten found

FINANCIAL:

Federal Judge John D. Clifford, Jr, at Portland, Me., signed an order enforcing the amended plan of reorganization for American & Foreign Power Co . . . Sale by the Arizona Edison Co of $1,500,000 in 4% sinking fund debentures has been approved by the Arizona Corporation Commission . . . Tallahassee, Fla., has sold a $5,000,000 issue of city power plant construction bonds bearing interest at 3.17%. A syndicate headed by Halsey, Stuart & Co paid $4,896,100 for the issue . . . Stockholders of Pennsylvania Power & Light Co have voted to increase the capital stock of the utility by 150,000 shares of preferred.

RELAXATION:

Last fall, New York P&L decided to build a dam across the Sacandaga River. A beaver colony made the same decision. Today the beavers have a 6-ft dam flooding about 15 acres. The utility is still clearing trees in preparation for construction . . . How a dozen pairs of birds' claws (minus the birds) became attached in a neat row to a portion of a 4-kv tap line is a mystery to a Union Electric Co line crew. The claws were found grasping a portion of the line far away from any possible ground.



CONTINUING NATURE of the electric power industry's capacity expansion program is shown by EEI's summary of additions from 1948 to 1953, inclusive. Chart above shows how

Capacity Expansion Program Grows

ELECTRIC POWER PLANT construction, first postwar industrial expansion baby to be born, is three and one-half years old next month and growing bigger every week.

Shortly before and immediately after V-E Day, WPB's Office of War Utilities released, through priorities or otherwise, about 2,000,000 kw of generating capacity for construction by U. S. power systems. This was the start of the power business' postwar expansion program.

Forty-two months later, the nation's central station plant has been increased by perhaps 5,800,000 kw, and orders for another 18,500,000 kw are quite firmly on the books.

Edison Electric Institute disclosed figures this week which cast the dimensions of the power industry's expansion program into bold relief. For the six years of 1948-1953, inclusive, EEI showed capacity expansion programs totalling 26,166,547 kw. These include public and privately owned systems alike. The yearly breakdown indicates that they may be low for federal government installations in the latter portion of the 6-year period. And power supply experts warn against the idea that EEI's figures for 1952 and 1953 constitute the size of the actual capacity construction programs of those years.

Orders for new generating capacity to be installed in 1952 won't begin to be complete before late next spring, these sources pointed out. They anticipate also that a few more orders of generating equipment for late 1951 installation will be placed before the books on that year are closed. Orders for the 1952 program should come in fast after power companies have had a chance to gauge this winter's demands and further time to study the business outlook for the early 1950's.

If the next six months give no more signs of a business slowdown than have yet appeared, the 1952 program might be as large as that now scheduled for 1951, in the opinion of one expert. EEI lists 6,056,200 kw for 1951 in the data it disclosed this week, 2,482,600 already booked or authorized for 1952, and another 388,000 for 1953.

Curtailments Ahead

Whatever the expansion from 1948 through 1953, it won't be enough to keep power systems from facing widespread necessity for voltage reductions and short-term curtailments of industrial customers this winter. Despite a record-breaking installation of new capacity this year, the outlook for 1948's peak load season is down somewhat from that of last winter, according to EEI's fourth loads and capacity survey. This showed a 4% capacity reserve nationally this year, whereas last year's figure was 5%.

Casting some light on what may be anticipated this year is this week's release by the Federal Power Commission of data on curtailments at the time of last December's peak. Polling 184 power systems and pools which furnish more than 98% of the nation's public supply, FPC found that curtailments then totalled 617,712 kw. Well over half of it—384,200 kw—came when interruptible customers were dropped. Voltage reductions accounted for 43,480 kw more; and other curtailments saved 9,805 kw of demand.

Load Reductions Made

Load reductions were reported by 64 of the 184 systems polled, or about 35% of Class I systems. December was the month in which reductions were made most frequently last year. The survey also showed that the heaviest curtailments, in terms of the percentage of annual non-coincident peak loads, came in Region VII, the Northwest, with 3.8%, and Region I, New England and the Middle Atlantic States, with 3.7%. Reported load reductions throughout the year totalled 1,278,000 kw.

Short-term curtailment of industrial customers, ranging from a few minutes to a few hours, are "practically certain" this winter in New England, New York, western Pennsylvania, Ohio, Indiana, Illinois, the Southeast, Wisconsin, and West Virginia, one industry expert told ELECTRICAL WORLD this week. They are not certain in the Pennsylvania-New Jersey-Maryland interconnected area and in lower Michigan.

California Looks Best

Voltage reduction and the dropping of interruptible customers are to be anticipated in almost all major power supply regions except California, this source added. The Inter-Mountain region probably will get by without much difficulty unless it encounters trouble through trying to export to the Northwest, which, as a region, is in the worst shape of all, according to all the figures.

Numerous sources agree that the Northwest will have a shortage ranging up to 150,000 kw on peak this winter, even with a normal water year. But certain local factors look as if they will mitigate the impact of the capacity shortage there. For one thing, there is some anticipation that water flow there this winter will be better than "normal." For another, in this region, peak demand is a function of aluminum production. So tremendous reductions can be made easily.

TWO MEN were needed to break ground for the 400,000-kw Yates Plant of the Georgia Power Co; so C. B. McManus, left with shovel, president of Georgia Power, called in W. B. Hammond, president of the Newman, Ga., Chamber of Commerce, to share the honors

UWU-CIO Sets Goals for Coming Year, Will Strive for Welfare Plans

THE CIO UTILITY Workers Union of America charted its moves and set up its goals for the coming year at its third constitutional convention at Washington, Oct 15-17.

On the strike front, the convention rejected a resolution advocating support of all strikes irrespective of whether the union involved has filed non-Communist affidavits. It urged, however, repeal of state utility anti-strike laws and of the Taft-Hartley Act.

Public ownership of utilities was opposed "so long as private ownership is productive of good labor-management relations and remains a responsible management in its administration."

The union will seek appointment of its members to public service commissions because government regulation of utilities "crucially affects the welfare of the employees of utility companies."

Pensions and welfare plans were covered in four resolutions adopted. The union will (1) seek removal of state laws which prohibit the passing of pension costs to the consumer, (2) seek inclusion of "adequate" health and pension plans in its contracts as permitted by the recent NLRB decision, (3) seek adoption by state legislatures of a law establishing "contractual pension plans" for employees of privately owned utilities, and (4) ascertain, and report to the next convention in April, 1950, the feasibility of having Congress enact a "Public Utility Retirement Act."

Better vacation and sick leave plans will be sought in UWU contracts.

The convention commanded UWU officers and locals to "seriously work for" a $1 minimum hourly rate in all contracts and to fight "all out" for "substantial wage increases" without any cost-of-living escalator clause, which was described as an employer "trap." A research department has been established by the union to make comparative wage studies for use in negotiations and also to analyze the provisions of all UWU local contracts.

The convention also endorsed President Truman's election and urged greater benefits and lower age requirements under Social Security.

Officers of four California locals, representing employees of Pacific Gas & Electric Co, were ordered suspended pending a hearing. The executive committee was authorized to appoint administrators to run the locals.

The locals are 133 in San Francisco, 137 in Redwood City, 169 in Martinez, and 241 in Santa Rosa. The "wrongful conduct" attributed to their officers included the conducting of negotiations for transfer to AFL's International Brotherhood of Electrical Workers, refusal to adhere to UWU policies, and refusal to permit representatives of the national office to attend membership meetings or collective bargaining sessions. Some delegates suggested that Communists may have infiltrated the locals.

Financial assets of the union increased from $99,500 to $127,600 during the past year and membership from 72,000 to about 75,000. At the request of the officers, all of whom were reelected, a proposed 10% increase in their $125 weekly salary was defeated.

•

5 States Sign Compact on Upper Colorado Basin

Five Western states are near agreement on a series of major power and irrigation projects proposed for the Upper Colorado River and its tributaries. The Reclamation Bureau hopes to ask Congress for funds to start some of these developments in the near future, possibly next year.

Major barrier to construction of the projects fell Oct 11 when Utah, Colorado, Wyoming, New Mexico, and Arizona signed the Upper Colorado River Basin compact at Santa Fe. The agreement ended the long squabble over upstream Colorado River water, allocating definite shares to each state.

The agreement still must be ratified by the legislature of each state, then be approved by Congress.

Signing of the compact was seen as a victory for the Reclamation Bureau, whose representatives long have been attempting to work out interstate agreements for development of the stream. Since the signing of the 7-state Colorado River Basin compact in 1922, the Bureau's activities in the region have been limited largely to construction of Hoover, Davis, and Parker Dams. The bitter fight between Arizona and California still blocks Bureau plans for further development of the Lower Colorado Basin. The 1922 agreement simply divided water between the upper and lower basins.

Arizona, which has a comparatively small strip of land in the upper basin, will receive 50,000 acre ft annually. The remaining available water will be divided as follows: Colorado, 51.75%; Utah, 23%; Wyoming, 14%; and New Mexico, 11.25%.

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Adding Second Generator

The Tucson (Ariz.) Gas, Electric Light & Power Co has ordered a second 11,500-kw steam turbo generator. It will cost $1,800,000 and will be placed in operation by October, 1949. The first unit will be working by next June. The two additions will boost production to 60,000 kw.

Future Result not Present Problems Stressed by Indiana Electric Group

"INTEREST IN the foot race between installed capacity and growing demands must not for one moment obscure the industry's vision of the result. As operating companies we must not only be interested in the outcome of that race, but also in its effects on investment, rates, operations, personnel, and community."

More than 450 executives and engineers heard C. K. Graham, president, Indiana Electric Association, open and set the theme with that statement for the Association's fall meeting in French Lick last week.

Load Factor Important

The need for greater utilization of investment was stressed by Edwin Vennard, vice-president, Middle West Service Co. He emphasized that "each company should aim to keep its reserves to a minimum consistent with good operation and to increase its operating load factor to a maximum." A company operating with a plant reserve of 10% and a net return of 5.92% would drop its net to 5.57% with a plant reserve of 20% and to 5.2% with a reserve of 30%, he stated. Illustrating the effect of load factor upon percent return, he said that a company earning a 5.52% return with a 55% load factor could increase this to 6.7% by raising the load factor to 65%.

Adam S. Bennion, vice-president, Utah Power & Light Co, discussed the industry's need to discover and develop young men for its ranks, to increase its interest in safety, to perfect relations between management and labor, and to tell the story of American industry to the public.

EEI President on Program

In his discussion of government competition, E. R. Acker, president, Central Hudson Gas & Electric Corp and Edison Electric Institute, said:

"The real issue underlying the Johnson Bill is of vital significance to all American business. It is simply whether or not the tax power of the nation should be used to destroy the free enterprise system. As an American I hope that Congress will vote on that issue in that light. I am sure that if it does the bill will be overwhelmingly defeated."

Community problems must be analyzed and solved with the same care and zeal given to technical problems, A. C. Spurr, president, Monongahela Power Co, contributed. "Let's admit we're selfish," he suggested. "Let's tell them we're in business to make money and that only by making money can we continue to give them the calibre of service to which they are entitled."

The heat pump has come a long way, A. C. Crandall, vice-president, Indianapolis Power & Light Co, reported. "In fact," he concluded, "it appears reasonable to expect a practicable commercial available unit for domestic use within the reasonably near future since many of the design problems which have been responsible for its slow advance have been solved or are nearing solution."

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Survey on Loss of Field Reported to PEA Group

The infrequency of damage to generators resulting from the loss of field excitation was a surprising fact revealed last week by a survey among utilities in the Pennsylvania area. Out of 15 utilities surveyed, six had provided some form of loss-of-field protection on 64 generators. In the last five years, however, only 16 cases of loss of field were experienced on these machines. In only one case was the machine damaged.

These facts were revealed in a paper presented by G. B. Miller, Duquesne Light Co, at the fall meeting of the Relay Subcommittee of the Pennsylvania Electric Association, in Reading.

In view of the infrequent damage from loss of field, Miller concluded from the survey that "absence of loss-of-excitation protection on rotating machines is not a serious thing and perhaps not warranted at all."

Discussers who had experienced loss of excitation on a loaded generator, however, uniformly stressed the vital necessity for clearing such a machine from the system quickly and keeping it off until the cause of the trouble was found.

Disclosure that supervisory equipment for telemetering, relaying, and communication that makes use of the 952 to 960 megacyle micro-wave radio band will be commercially available in the near future was made by W. A. Derr, Westinghouse Electric Corp. He reported that this band as well as some higher frequency bands are now available for experimental installations.

E. Wylie Head, Control Corp, pointed out that the use of open-wire channels for supervisory control allows operation over distnces of 50 to 75 miles and also permits a larger number of functions to be carried simultaneously. Where extreme distance is involved, however, a carrier current channel, operating over transmission lines, is probably the most satisfactory channel, Head said. He noted, however, that more and more power companies are investigating the use of radio channels for supervisory control and telemetering and suggested that under some conditions radio channel may be the most reliable and least expensive type of channel.

Paul Schirmer, General Electric Co, described and demonstrated a code-selector, all-relay type of supervisory control system that provides up to 128 different control points. Schirmer said that no more than 100 points have been required to date in any of the 75 installations now in use.

F. S. Fehr, Metropolitan Edison Co, reported the experience of his company with pressure-type relays for the protection of four 12,500-kva conservator-type transformers. It was found that a two-pound differential in setting above static pressure was apparently too close to avoid false operation on through faults. However since relays were reset to three pounds, no false operations have been experienced from through faults.

•

Reclamation Must Fire 800 More Under Ruling

About 800 more Reclamation Bureau employees will lose their jobs in the latest of the agency's belated moves to comply with the legal ceiling on its payroll.

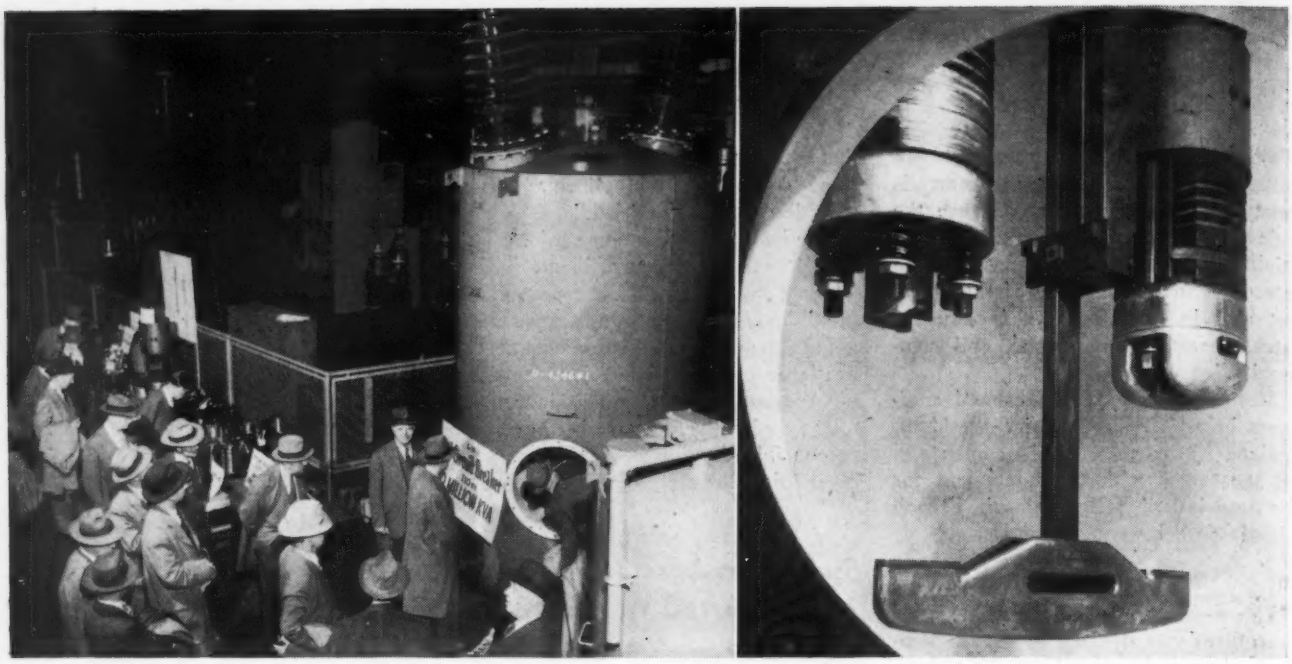
The new cut, announced Oct 13 by Assistant Secretary of Interior Warne, is in addition to previous Bureau plans to drop approximately 3,000 workers. It was necessitated, Warne said, by a ruling of the Comptroller General.

Reclamation previously had interpreted language in the 1949 Interior Appropriation Act limiting the Bureau's payroll to a total of $48,000,000 as applying to employees paid from appropriated funds. But the Comptroller General ruled that it covered employees paid out of trust funds as well.

•

St. John, N. B., to Buy Lines

The power distribution system of the New Brunswick Electric Power Commission in St. John, N. B., will be purchased by the city for $1,500,000. A bond issue will finance the purchase. The generating plant will be retained by the provincial commission, which obtained it and the lines from the New Brunswick Power Co by expropriation Jan 1.



10,000,000-KVA oil circuit breaker at testing ground of the Westinghouse Electric Corp, East Pittsburgh, attracts members of the EEI Prime Movers and Equipment Committees, AEIC Switchgear Committee, and Westinghouse's own district sales managers. In panel at right is the interior of the breaker as seen by the man peering into it at the lower right hand corner of the panel at the left

Station Starting-Up Mishaps Placed on Haste in Getting Units on Line

PRESSURE FOR SPEED in getting new units on the line is accentuating the risks of curtailing final checking and testing of equipment and connections. This was the consensus at a meeting of the EEI Electrical Equipment Committee at Pittsburgh, Oct 14 and 15, after Vice-President H. E. Deardorff described the feat of getting the O. H. Hutchings Station of Dayton Power & Light Co into service in July only 19 months after ground-breaking. Another major theme was the saving now obtainable by using welded aluminum for outdoor buses.

To offset the "colossal lack of responsibility on the part of the contractor's workmen," who committed almost unbelievable jeopardies of equipment, a thorough checking and testing program was recognized as a necessity but many items had to be passed by. Despite the seven outages during the ensuing break-in period, the 19-month accomplishment was deemed remarkable.

Considerable checking was done at the factory, insulation was ohmed and power factor tested, control cables were end-taped, and particular effort made to determine minimum operating current of all control mechanism.

Apparatus was received improperly wired and one battery arrived upside down and broken. Boiler control panel meters were badly damaged in rail transit. A bricklayer's strike left one wall unfinished and a driving rain went clear through the plant after operations had been started.

Discussion brought out (1) tendency to omit high potential testing but to focus on insulation power factor tests for reference data, (2) resort to trucking to escape freight damage, (3) a disposition to admit that half the auxiliary motors will first run backward no matter how thoroughly they are phased out, (4) a difference of opinion on the need for apparatus dry-out, (5) a consensus that eternal vigilance and less "heat" from management in the final week or two are the antidotes for the present concomitance of relentless demand and lackadaisical "help."

Savings of approximately one-third were effected at the new Sewaren, N. J., plant of Public Service Electric & Gas Co by resort to welded aluminum buses for the 13/132-kv switching station. This gain was due to the lower cost per mho despite the $35-$75 excess cost of a welded joint or tap over that for bolted copper. D. M. Quick's paper had been preceded by one by L. T. Guess, Aluminum Company of America, in which the latter calculated that the 39/37 price ratio of aluminum to copper offers a 48% advantage for the former on a resistance basis, 52% on a thermal basis and 28% on loss basis.

A. P. Fugill's paper recorded the present and prospective evolution of Detroit's bulk power system on a close-coupled, balanced-area philosophy. Loops are notably the rule for the subtransmission. Successful performance of Duquesne Light's 10,000-kva series capacitor was reported by E. A. Hester.

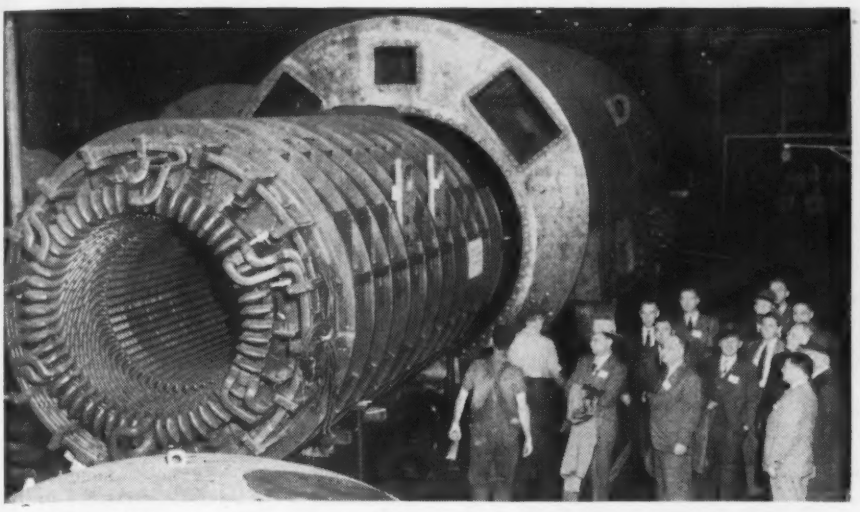
Periodic rotated cutoffs with stiff penalties for violations of equally stiff regulations are on the docket for the Ontario areas to conserve capacity for winter load requirements when the North Canada rivers freeze up. The August-September drought was reported severe by A. V. DeBeech (Canadian-Brazilian Services). In the utilization discussion, much concern was expressed over the concentrations of washing machines ("young" laundries, one called them) with their cyclic starting and operation as a flicker causation. A parallel item of concern was the broader matter of branch circuit protection.

Chairman Van Ness told the 85 members and guests that the next meeting will be in St. Louis in February.

•

Rate Increase Upheld

The annual $327,914 rate increase awarded to the Georgia Power & Light Co has been upheld by Fulton, Ga., Superior Court Judge Bond Almand. Consumers in 25 southern Georgia towns and two Valdosta businessmen had charged the increase was "unjust, unreasonable, arbitrary, and discriminatory."



EEI AND AEIC committee members inspect 105,000-kva hydrogen-cooled alternator in East Pittsburgh Works of Westinghouse Electric Corp. Alternator will go to Toledo Edison Co

Distribution Subjected to Intensive Economic Analysis at EEI Meeting

CRITICAL STUDY of distribution design, advances in aerial cable design and installation, and merits of statistical sampling were major themes of the Edison Electric Institute Transmission and Distribution Committee meeting at Swampscott, Mass., Oct 11 and 12. Other discussions included voltage regulation, hermetic sealing of transformers, flicker, and fuse standardization. Anaconda Wire & Cable Co announced availability of Hy-therm copper conductors of raised annealing temperatures (See Page 146).

Progress was reported by C. J. Beller, Cleveland Electric Illuminating Co, on behalf of the joint AIEE-EEI subcommittee working on a basic analysis of the comparative reliability of the various distribution patterns. A comprehensive questionnaire has been framed to bring out the performance factors and lead to conclusions which, it is hoped, will resolve the confusion and opinionation surrounding distribution.

Considerable time and interest were devoted to aerial cable composition and installation. R. C. Waldron, Okonite Co, gave the details of "Line-Tap" cable of Dualay (reverse-lay) assembly. This was followed by a film on the spinner job done by Florida Power & Light Co (EW, April 24, Page 69).

A lucid and persuasive exposition of statistical sampling methods for insulator tests by J. J. Taylor, Ohio Brass Co, prompted Chairman T. J. Brosnan, Buffalo Niagara Electric Corp, to suggest that they could well be applied to data on outages, equipment performance, etc. Taylor said the method saves money if (1) the standards refrain from specifying minimums and (2) the procedure avoids discarding the information about dispersion of the large fraction of superior specimens.

Discussion of optimum substation regulation and distribution pattern led L. M. Olmsted, Duquesne Light Co, to tender data supporting the efficacy of neutral compensators to restore neutral in the case of unbalanced 3-phase load and single-phase regulation. Next in order he placed omission of the neutral compensator (with emphasis on phase balancing) and then the 3-phase regulators, the latter principally for feeders not over ½ mile. In the discussion there were advocates of both feeder and bus regulation. H. P. Seelye, Detroit Edison Co, and D. K. Blake, General Electric Co, both advocated using the most feasible method, whether it be capacitors, boosters, regulators, or more copper.

Cable failure rates in 1946 were (for 14,100 miles on 16 systems) up to 5.6 per 100 miles, a new high, said E. F. Neuzel, Cincinnati Gas & Electric Co, and indications are that 1947 will show a 7.6 figure, presumably due to the abusive loadings.

A symposium on non-metallic sheathed cable seemed to indicate that Neoprene is supplanting braids and that shielding should be provided above 7.5 kv (some said 5 kv). J. E. McCormack said Consolidated Edison Co uses it only for secondaries on underground. T. J. Brosnan mentioned a foreign installation of polyethylene primary cable in Transite buried under the sidewalk. He and others were unconvinced that anything but rubber and lead gives adequate long-term assurance. W. A. DelMar, Habirshaw, favors metallic sheath for primaries, and R. J. Wiseman, Okonite, was lukewarm about thermoplastics and said omission of lead dictated the best of insulation.

Practically complete elimination of gaskets on submersible transformers has been effected on the Consolidated Edison system by welding, said C. P. Xenis. Corrosion protection, however, becomes the next imperative item.

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Canadian Power Outlook Gloomy as Usage Rises

With statistics now available for the first seven months of 1948 on the output of Canadian central stations and the consumption of primary power, Canadians can now look to the future with some misgivings. Consumption of primary power was 10.3% higher than for the corresponding period of 1947, output a little over 1.2% less.

The Ontario Hydro-Electric Power Commission has already placed restrictions on the use of electricity. If the dry weather continues, the restrictions are certain to become more severe. Other provinces may be forced to follow suit.

July output was only 3,664,554,000 kwhr, lower than any month since last November, except 29-day February. However, primary consumption of 3,362,866,000 kwhr was the highest ever recorded for July. This was the twenty-fourth successive month that primary consumption exceeded that of the corresponding month a year previous.

The following statistics, supplied by the Dominion Bureau of Statistics, are in thousands of kilowatt hours:

Period	1948	1947
Seven months	26,217,421	26,549,238
Primary	24,313,074	22,163,226
Secondary	1,904,347	4,386,012
Primary Consumption	23,531,833	21,328,335
Exports to the U. S.	1,022,876	1,287,700
July	3,664,554	3,750,881
Primary	3,478,025	3,173,552
Secondary	186,529	577,329
Primary Consumption	3,362,866	3,048,202
Exports to U. S.	150,940	217,171
June	3,724,019	3,756,104
Primary	3,456,054	3,134,862
Secondary	267,965	621,242
Primary Consumption	3,337,356	3,017,163
Exports to U. S.	169,890	192,227

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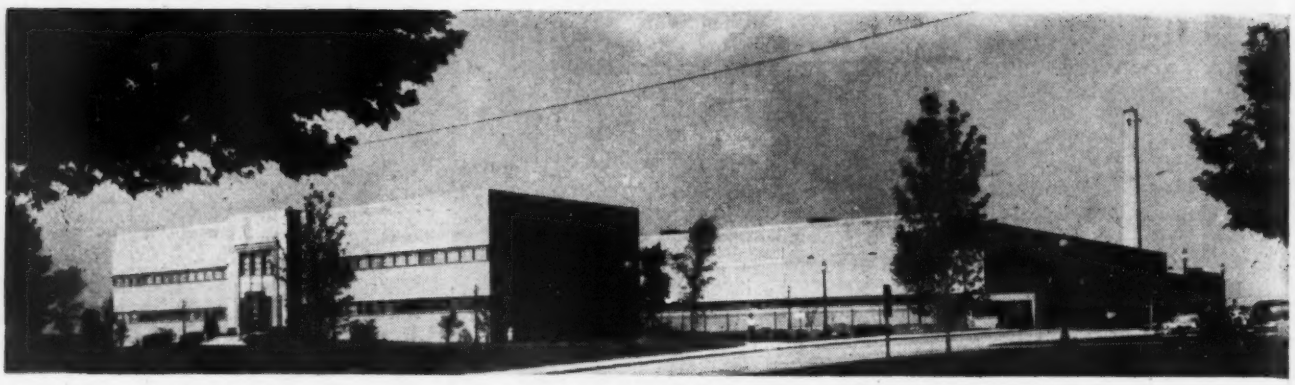
Holden Will Head PSC

State Attorney James Holden has been appointed chairman of the Vermont Public Service Commission, succeeding Col Paul A. Chase, who was made a superior court judge.



ALLENTOWN, PA., PLANT of the Western Electric Co, which was formally opened last week. Plant manufactures electronic equipment

Sho-Me Power Will Sell Properties for $219,000

Sho-Me Power Corp, Marshfield, Mo., has been given permission by the Missouri Public Service Commission to sell its electrical distribution lines and plant facilities in Cuba, Mo., and in Pemiscot, Stoddard, Cape Girardeau, Bollinger and Scott Counties for $219,000.

The City of Cuba will buy the Sho-Me property there for $55,680, to be paid in city revenue bonds. The utility's properties in Bollinger, Cape Girardeau and Scott Counties and certain parts of Stoddard County will be taken over by Scott-New Madrid-Mississippi Cooperative, Sikeston, for $98,068, the amount of Sho-Me's debt to REA.

The Ozark Border Electric Cooperative will purchase certain Sho-Me distribution systems in Puxico, Mo., and other parts of Stoddard County, assuming a $65,523 Sho-Me debt to REA. This sale also includes a water system and an electric generating plant in Puxico.

Ozark Border Cooperative, an REA co-op, serves 5,300 members, and Scott-New Madrid-Mississippi serves 4,090 members.

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San Antonio Ownership of Comal Plant Upheld

The City of San Antonio's ownership of the Comal steam generating power plant at New Braunfels, Tex., has been upheld by the State Supreme Court. The high tribunal recently refused to review lower court findings that denied an ownership claim by the city of New Braunfels.

New Braunfels had clamed its right of local self-government was invaded by San Antonio's 1942 purchase of the plant from a private utility. The plant later was leased to the Guadalupe Blanco River Authority, which assigned the lease to the Lower Colorado River Authority.

SEC RULINGS

NIAGARA HUDSON POWER CORP's proposal to acquire all of the outstanding capital stock of the Old Forge Electric Corp in consideration for the cancellation of certain promissory notes has been approved. Niagara Hudson holds, as collateral security for the certain promissory notes of A. Augustus Low in the amount of $684,498, all of the outstanding capital stock, consisting of 6,300 shares of Old Forge Electric Corp. The notes are collectible only through recourse to the collateral. The notes are carried by Niagara Hudson at $368,443, the book value of the stock of Old Forge stock at Feb 1, 1937. Subsequent to its acquisition of the Old Forge stock, Niagara Hudson proposes to forgive a demand note of Old Forge due to Niagara Hudson in the amount of $133,904, and interest receivable in the amount of $197,596, the total of such indebtedness being $331,500. Old Forge, which has been operated for some years as a unit of the Niagara Hudson system, will eventually be merged into Niagara Hudson's subsidiary, Central New York Power Corp, although such merger is not a proposal under the present filing. (Release No. 8544).

NORTHERN STATES POWER Co's proposal to acquire from the City of Grand Forks, N.D., for a cash consideration of $18,000 the existing municipally-owned overhead street lighting system of the city, has been approved. Northern States is a Minnesota corporation, a registered holding company and an operating utility company and a subsidiary of Northern States Power Co, a Delaware corporation, also a registered holding company. Upon acquisition, the company proposes to integrate said system with its existing distribution facilities and to enlarge and modernize the street lighting system in accordance with contractual agreements heretofore agreed upon with the city. (Release No. 8545).

AMERICAN LIGHT & TRACTION Co has been ordered to take immediate steps to retire its outstanding preferred stock. SEC stated that a plan calling for retirement of the issue was approved last December. (Release No. 8538).

PENNSYLVANIA EDISON Co has been authorized to make further payments to the holders of the $5 and $2.80 series of preferred stock, to the amount of $5 and $2.50 a share, respectively. These amounts are in addition to the liquidation prices already paid for the preferred stocks which were retired on July 2, 1946. The commission held that the value of the preferred stocks at the time of their retirement was at least equal to their redemption prices. In addition, the commission contended that the owners of preferred stock were entitled to compensation for delay in payment of the additional amounts from July 2, 1946, to the actual date of payment, at the rates of 6¼% and 5¼% a year, respectively, on the $5 and $2.80 preferred stock series. (Release No. 8550).

MEETINGS

PREVIOUSLY LISTED

Missouri Valley Electric Association—Engineering Committee, Hotel President, Kansas City, Mo., October 26; Rural Round Table, The Elms, Excelsior Springs, Mo., October 27; Sales and Rural Conference, The Elms, Excelsior Springs, Mo., October 28-29.

Pennsylvania Electric Association—Prime Movers Committee, Carver House, Warren, Pa., October 28-29.

Southeastern Electric Exchange—Accounting Section, Sir Walter Hotel, Raleigh, N. C., October 28-29; General Sales Conference, Atlantic Biltmore Hotel, Atlanta, Ga., November 10-12.

Wisconsin Utilities Association—Commercial and Technical Divisions of Electric and Gas Sections, Pfister Hotel, Milwaukee, November 1-3.

American Institute of Electrical Engineers—Southern District Meeting, Tutwiler Hotel, Birmingham, Ala., November 3-5.

National Electronics Conference—Edgewater Beach Hotel, Chicago, November 4-6.

Public Utilities Association of the Virginias—Annual Meeting, Greenbrier Hotel, White Sulphur Springs, West Virginia, November 5-6.

National Electrical Manufacturers Association—Annual Meeting, Hotel Traymore, Atlantic City, November 8-13.

National Farm Electrification Conference—Congress Hotel, Chicago, November 17-19.

New Jersey Utilities Association—Annual Meeting, Seaview Country Club, Absecon, November 18-20.

American Society of Mechanical Engineers—Annual Meeting, Hotels Pennsylvania and New Yorker, New York, November 28-December 3.

National Exposition of Power and Mechanical Engineering—Grand Central Palace, New York, November 29-December 4.

National Electrical Contractors Association—Annual Meeting, Roney Plaza Hotel, Miami Fla., November 30-December 3.

Energy Sales in July Advanced 11.9% Over '47

Sales of electric energy to ultimate customers in July, 1948, totaled 19,367,345,000 kwhr, the Edison Electric Institute reports. This was an 11.9% increase over the 17,307,950,000 kwhr sold in July, 1947.

Revenues from ultimate customers amounted to $348,135,800, compared with $305,854,600 in July, 1947, an increase of 13.8%.

For the 12 months ended July 31, the average use per customer advanced to 1,513 kwhr from 1,392 kwhr for the preceding year, an increase of 8.7%; the average annual bill to $45.84 from $43.57, an increase of 5.2%; revenue per kwhr dropped to 3.03 cents from 3.13 cents, a decrease of 3.2%.

Classification of Sales, July

Kilowatthour Sales July	Million Kwhr 1948	1947	Percent Change
Residential or domestic	3,823	3,307	+15.6
Rural (Distinct rural rates)	637	606	+ 5.0
Commercial or industrial			
Small light and power	3,653	3,123	+17.0
Large light and power	10,035	9,068	+10.7
Street and highway lighting	170	160	+ 6.3
Other public authorities	489	459	+ 6.5
Railways and railroads			
Street and interurban	305	330	— 7.5
Electrified steam railroads	203	209	— 2.7
Interdepartmental	53	45	+16.9
Total to ultimate customers	19,367	17,308	+11.9

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State Denied Rehearing in First Iowa Dam Case

The State of Iowa lost another round of its seven-year battle to prevent the First Iowa Hydro-Electric Cooperative from erecting a power dam across the Cedar River.

The new blow fell last week (Oct 14) when the Federal Power Commission denied the state's application for rehearing of the case. Iowa also had asked FPC to stay its orders granting a license for the project. Though state spokesmen had no official comment, it is expected the matter will be taken into the courts again.

Other News

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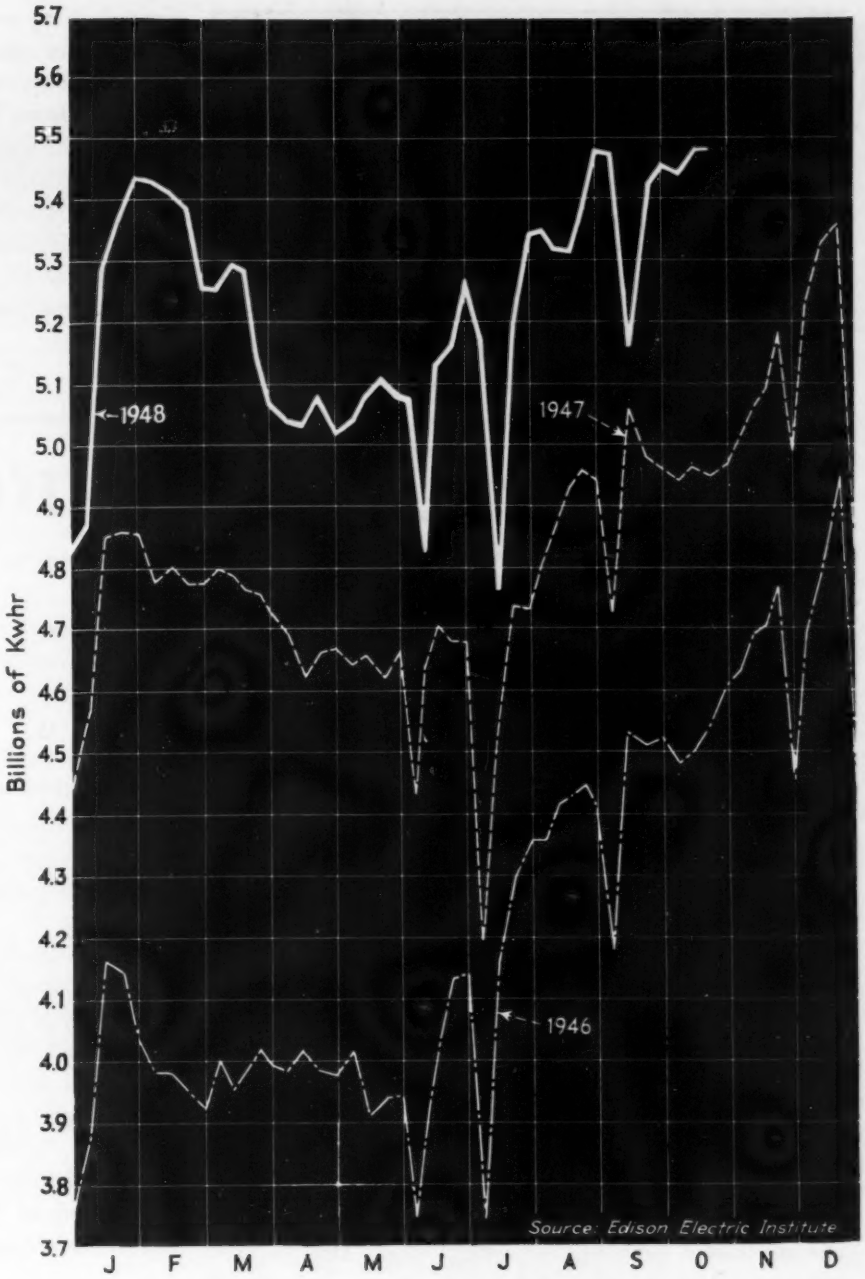

Week-Old Output Record Broken

Output records are only temporary these days when everybody is demanding more electricity. For the week ended Oct 9, central stations produced 5,481,632,000 kwhr for a new record. One week later (Oct 9), Edison Electric Institute reported output at 5,482,030,000 kwhr, a slight increase it is true but still a new record.

What should be more alarming to the utility industry is the percentage increase over the corresponding week of a year ago. For the week ended Sept 25, the increase was 10.2%. A week later the increase was 10.4%. For the week ended Oct 16, this had grown to 10.6%. For the last week reported the increase was 10.8%. At this rate, the utilities can look forward to running at least 11% higher in December than in the same month of 1947.

Weekly Output, Millions Kwhr

1948		1947		1946	
Oct 16	5,482	Oct 18	4,946	Oct 19	4,540
Oct 9	5,482	Oct 11	4,958	Oct 12	4,495
Oct 2	5,449	Oct 4	4,935	Oct 5	4,478
Sept 25	5,461	Sept 27	4,956	Sept 28	4,518
Sept 18	5,426	Sept 20	4,977	Sept 21	4,507
Sept 11	5,166	Sept 13	5,053	Sept 14	4,521
Sept 4	5,470	Sept 6	4,721	Sept 7	4,184
Aug 28	5,478	Aug 30	4,940	Aug 31	4,404
Aug 21	5,391	Aug 23	4,953	Aug 24	4,444

Percent Change from Previous Year

	Oct 16	Oct 9	Oct 2
New England	+ 6.0	+ 6.4	+ 5.5
Mid-Atlantic	+ 6.2	+ 7.4	+ 7.3
Central Industrial	+11.7	+11.1	+ 9.8
West Central	+11.6	+ 9.2	+12.8
Southern States	+11.6	+11.6	+13.3
Rocky Mountain	+14.6	+14.1	+ 9.3
Pacific Coast	+14.0	+12.8	+12.1
Total United States	+10.8	+10.6	+10.4

WASHINGTON COMMENT

WILLIAM B. WHICHARD

ACCORDING to best available estimates, the nation's fuel outlook is much brighter for the coming winter than it was a year ago. Government and industry sources unanimously predict that more coal, more oil, and more gas will be available to the consumer. That does not mean that everyone will have as much fuel as he wants—far from it. But it is a firm indication that fuel suppliers finally are beginning to catch up in their race with equipment shortages and ever-increasing demand.

Too many imponderables are involved to predict when this race finally will be won. But immediate prospects are that coal supply will keep ahead of demand this winter. Fuel oil will come close to meeting requirements with the continuation of consumer conservation, and gas will be in slightly improved supply.

Fuel gas still presents the knottiest supply problem and probably will continue to do so for years to come. In addition to equipment shortages faced by all industries as a result of the war, the gas suppliers have all the expansion headaches of a new and rapidly booming business. In natural gas, they have a product for which demand is apparently unlimited.

Since a major portion of the industry is subject to regulation as a public utility, the problem of living—let alone expanding—in spite of the double-barreled demand-equipment barrier has been fraught with highly explosive potentialities. Fortunately, both local and federal regulatory agencies have been able to grasp the magnitude of the problem.

Result has been that utility regulators have ordered service curtailment in all critical areas for winter peak periods. These curtailments must continue during the coming winter, probably for several more. But the curtailment orders, though both helpful and necessary, afford only partial and temporary relief.

The supply situation will ease this winter largely because of the increased availability of other fuels, which can carry more of the demand burden, and because the gas industry is striving mightily to help itself.

Pipeline companies have installed new compressors and looped lines with all the equipment they can lay hands on. Result will be increases in the natural gas available in many areas of great demand. For example, the so-called Appalachian Area, hard hit by fuel shortages last winter, will get 20% more natural gas.

Distributing companies have resorted to other means for meeting winter peak loads. During the summer, gas was stored underground in old gas fields in the Detroit area. Outside Chicago and in California, gas utilities buried nests of pipe, put gas under pressure into them for use in the winter. Other companies are returning retired plants to service and will mix manufactured gas with natural to meet peak demands in coming months.

The latter measures, like service curtailments, of necessity are temporary steps. When sufficient equipment is available, some 20,000 miles of new pipeline links will be constructed. If natural gas retains its present competitive price position in relation to other fuels, all this will not be enough. But even regulatory agencies, which have watched pipeline construction costs mount from a prewar level of $50,000 per mile to nearly twice as much, doubt that natural can be sold for long at present delivered prices.

TECHNICAL TRENDS

ARCHER E. KNOWLTON

Emergency loading may admittedly save in transformer investment but it puts a burden (and perhaps added outlay) on the system's voltage regulators.

Auxiliary motors fed from a common station source will supply one another, induction-generator fashion, through inertia and residual flux when the source fails. The result may be beneficial unless the voltages get far out of phase with a restored supply.

High-voltage cables are available in so many dissimilar concepts and styles that somebody should set them down in parallel columns, enumerate the strong and weak points for representative situations and help dispel the confusion about relative economics. Any takers ready and willing?

Flicker definitely can be diluted by banking but only if the cause of the flicker is not on the feeder ahead of the banked transformers.

Multiple lighting would undoubtedly rise as percentage of the total if the means of on-and-off control satisfied more of the critics.

Air conditioning loads can be rotated for diversity on peaks by means of the same kind of carrier used for water heaters.

Jewels will be needed for new meters and instruments and for replacements and this country should support a synthetic industry against possible shut-off of imports.

Diesel-driven generators are going up in rating. Mexico is getting six of 7500 kva (6000 kw) rating.

Carrier costs are largely terminal costs. Therefore the way to use carrier advantageously is to distribute the cost among more uses and more units.

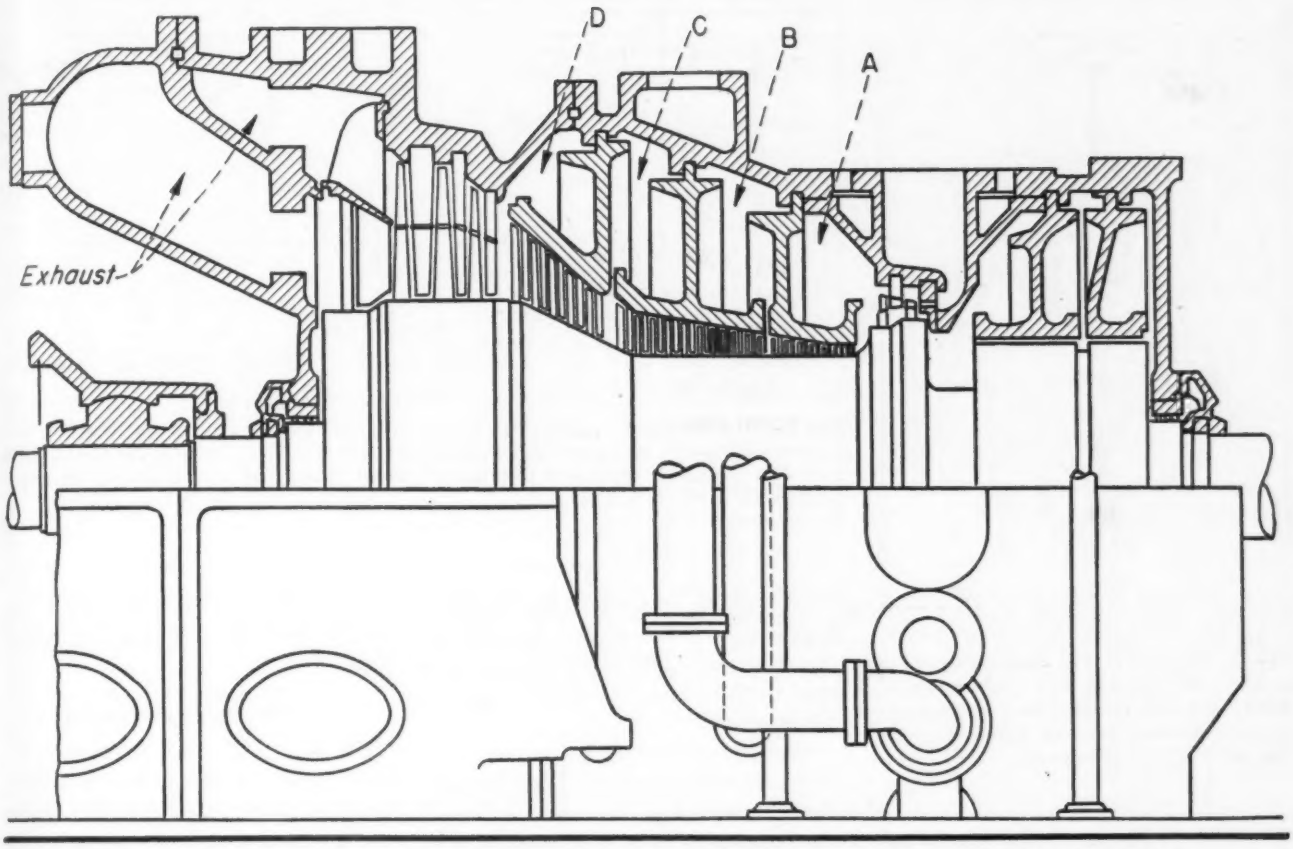

FIG 1—STAGES 21 TO 24 in Section D were damaged. Blade ring (21 to 25) was replaced by a special throttling diaphragm

Temporary Throttling Diaphragm Gives Rated Output from Damaged Turbine

Substitution for five stages during wait for factory replacement permits loading to 90% of the machine's capability instead of 25% over 5 month period

GEORGE G. GUTHRIE
Mechanical Engineering Division
American Gas & Electric Service Corp
New York

OBTAINING 20,000 kw instead of 7,500 kw out of a turbine rated 20,000 kw (25,000 kva) is practicable is an emergency even with 5 stages of blading removed. This was achieved recently with a Westinghouse Type 328 CW, 1800 rpm, condensing turbine with 29 stages, using team at 400 psi and 700 F. A throttling diagram giving equivalent pressure drop took the place of the 5 stages until new blading could be obtained.

Over a period of several weeks there had been a gradual increase in the turbine's vibration. Several balancing trials were made by an expert from the manufacturer and the vibration was brought back to an acceptable level. After about two weeks, during which the turbine was taken off the line every night, operation suddenly became "very rough." The machine was immediately shut down and the turbine cover removed. In three stages, namely, 21, 22 and 23, both spindle and stationary blading was found to be mashed over and the blading in the 24th stage badly bent. Consequently, the spindle blading of the 21st through 24th stages was removed by burning off.

Output Limited

Because of excessive pressure drop across the remaining blading at high steam flow through the turbine, it was necessary that the load be limited to 7,500 kw. To assure adherence to this limitation even in the event of

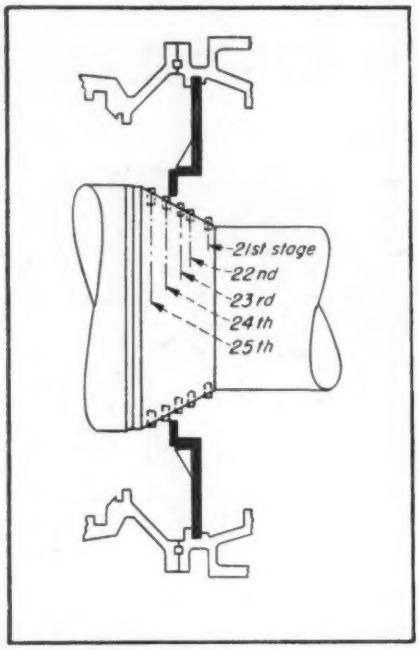

FIG 2—THROTTLING diaphragm inserted in place of blade ring with aperture around shaft computed to reestablish approximate normal operating pressure differentials for 240,000 lb per hr put-through

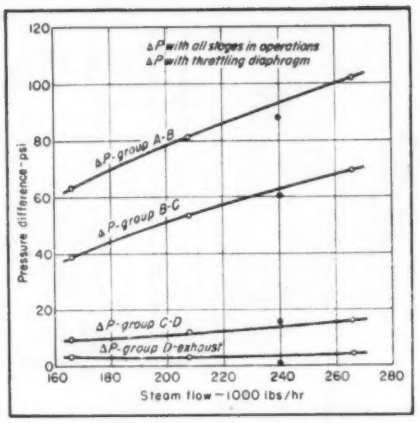

FIG 3—DIAPHRAGM results in stage pressure differentials nearly equal to normal. Solid dots show close agreement in pressure drop across sections with diaphragm

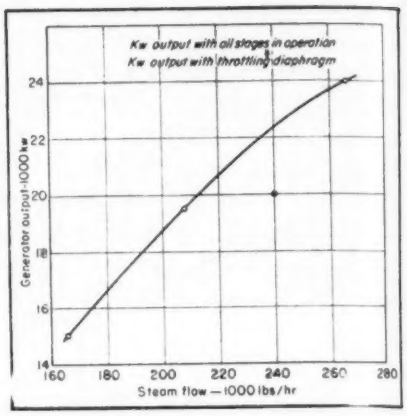
Kw output with all stages in operation
Kw output with throttling diaphragm
Generator output-1000 kw
Steam flow — 1000 lbs/hr

FIG 4—OUTPUT with the throttling diaphragm was 20,000 kw using the same 240,000 lb of steam per hour that had developed 22,400 kw before the blading failed

a system disturbance, the secondary and tertiary admission valves were disconnected and a stop put on the stem of the primary valve.

Removal of the third blade ring which carries the stationary blading of stages 21 through 25, all of which was damaged except the 21st and 25th, would not affect the imposed limit of 7,500 kw. Therefore, advantage was taken of the opportunity to send this blade ring to the manufacturer's shop for repairs contemplated from previous general inspections of the turbine. Water cutting on the bore of the blade ring behind the blade rows had reduced the effective depth of the blade grooves.

The condition is being corrected by machining the bore of the blade ring and installation of brass liners to protect against further water erosion. At the same time the blade grooves will be cut deeper and new blades with larger roots than the original ones will be installed.

Six Month Delay

Although the new stationary blades for the 21st through 25th stages were already on hand, along with the brass lining material, and the repair of this third blade ring could be done in a few weeks, the five new rows of spindle blading would require at least six months to manufacture. In the meantime, we were confronted with a limitation of 7,500 kw capacity instead of the realizable 22,000 kw on this machine.

Since pressure drop across the stages was the cause of load limitation, the idea was conceived in conjunction with the manufacturer's engineers of the creation of an arbitrary pressure drop by means of a throttling diaphragm, shown in Fig 2, located in the space provided by the removal of the third blade ring. The required pressure drop is accomplished by the throttling which occurs across a carefully sized aperture between the diaphragm and the spindle. Incidentally, the diaphragm was made in two halves, thus permitting the lower half to be rolled into place without removing the spindle, utilizing the supporting groove in the casing ordinarily used for the third blade ring.

Blade Stubs Removed

It was believed that the calculation of pressure drop versus steam flow would not hold if there were any stubs of spindle blading remaining after the burning off of the damaged blading located in close proximity to the aperture either upstream or downstream. Therefore, such rows were machined off practically flush with the spindle contour while the spindle remained in place in its bearings and rotated by the turning gear. As an alternative, these blade roots could have been driven out. However, this plan was rejected because the spindle grooves would thus be exposed to moisture cutting for at least six months until the new blading would be installed.

Five Months Output Gained

The throttling diaphragm was designed and necessary drawings prepared in three days, the fabrication accomplished in two weeks, with the reassembly of the turbine completed five days later; a total of 26 days from the date of the blade failure until the unit was back in service at 20,000 kw capacity. During 17 days of this period the turbine was in operation at 7,500 kw load.

The results of using the throttling diaphragm have been most gratifying. When the turbine was operating normally before the blade failures, shell pressure readings were available at points A, B, C, and D shown in Fig 1.

These readings expressed as pressure differentials plotted against throttle steam flow are shown in Fig 3. Also shown are the pressure-differential readings taken after the installation of the throttling diaphragm, from which it can be noted that the pressure drops across the four sections of the turbine remain in close agreement.

While naturally the output would be less for a given steam flow with five stages removed, the attainment of 20,000 kw, compared to 22,000 kw when the turbine has all its stages in is a good realization of valuable capacity and certainly much better than limping along at 7,500 kw for six months or more while awaiting delivery of new blading.

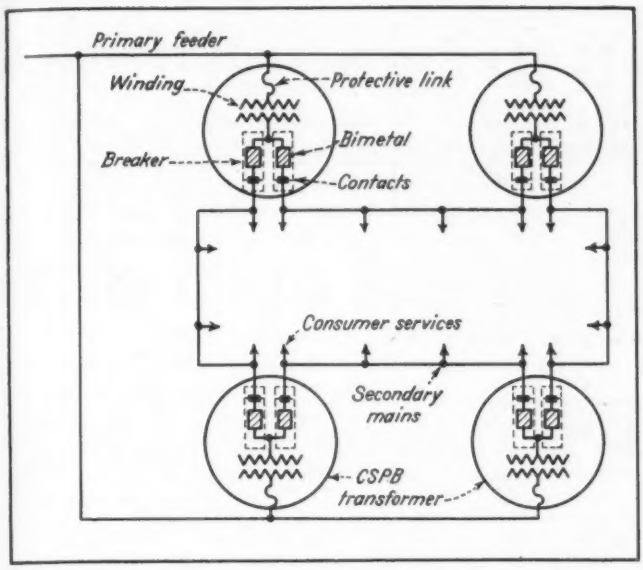

FIG 1—BANKED-SECONDARY SYSTEM using transformers with built-in secondary breakers, of the CSPB type, will solve sectionalizing problems. For secondary faults that don't burn clear, the breaker at each end of the faulted secondary opens to isolate the fault. Service is interrupted only to customers on the faulty section. Transformers stay in service.

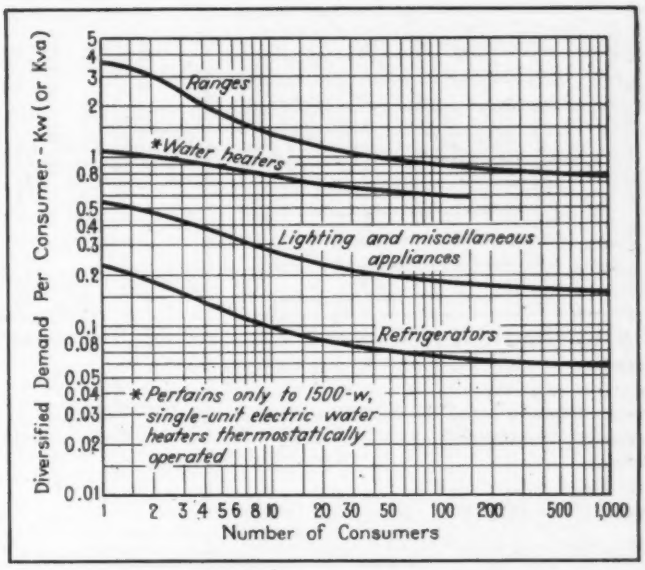
Diversified Demand Per Consumer - Kw (or Kva)
Ranges
*Water heaters
Lighting and miscellaneous appliances
Refrigerators
* Pertains only to 1500-w, single-unit electric water heaters thermostatically operated
Number of Consumers

FIG 2—PEAK DIVERSIFIED DEMANDS for four common types of residential loads based on range saturation of 5%. Diversified demand per customer for a particular combination of appliances found from the chart is multiplied by number of customers with such loads to secure peak demand of that particular load. Sum of such peaks for all types of loads gives peak area demand

How to Apply Transformers on Banked-Secondary Systems

A step-by-step outline of the procedure involved in the proper application of transformers to banked secondary systems. Proper transformer location, copper size for secondary main, voltage drop and flicker problems examined

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PLANNING a banked-secondary system is similar in most respects to planning the usual radial-secondary system. In both types of systems, transformers are located according to the occurrence of load and transformer spacings and secondary-main sizes are chosen to satisfy certain voltage conditions.

But, the proper division of load among transformers and the isolation of faults on the secondary main are problems peculiar to banked-secondary systems. A little care in locating transformers along banked-secondary mains will insure good load division. The use of modern transformers with built-in secondary breakers, such as the CSPB, will solve sectionalizing problems.

A banked-secondary system, Fig 1, has benefits of reduced lamp flicker, better average voltage and more effective use of transformer and secondary-main capacity. All these advantages can be obtained in most residential areas and in some heavily-loaded rural areas. This corresponds to load densities ranging from about 6.5 to 150 kva per 1,000 ft of secondary main, or 450 to 10,500 kva per sq mi in a uniformly-loaded area when secondary mains are 400 ft apart. Less densely-loaded sections should be served by radial feeds. Secondary networks should be considered for more heavily loaded areas.

Total Load in Area

The first step, after selecting the banking area, is to determine the peak demand for the area involved. The preferred way is to measure it with a recording instrument on the primary feeder at the time when the peak load

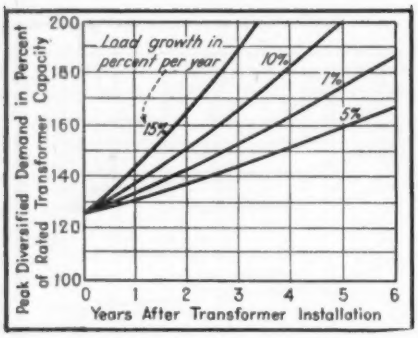


FIG 3—LOAD GROWTH CURVE shows increases in transformer loading over several years corresponding to four annual growth rates. Chart is based on an initial average maximum transformer loading of 125% of rating

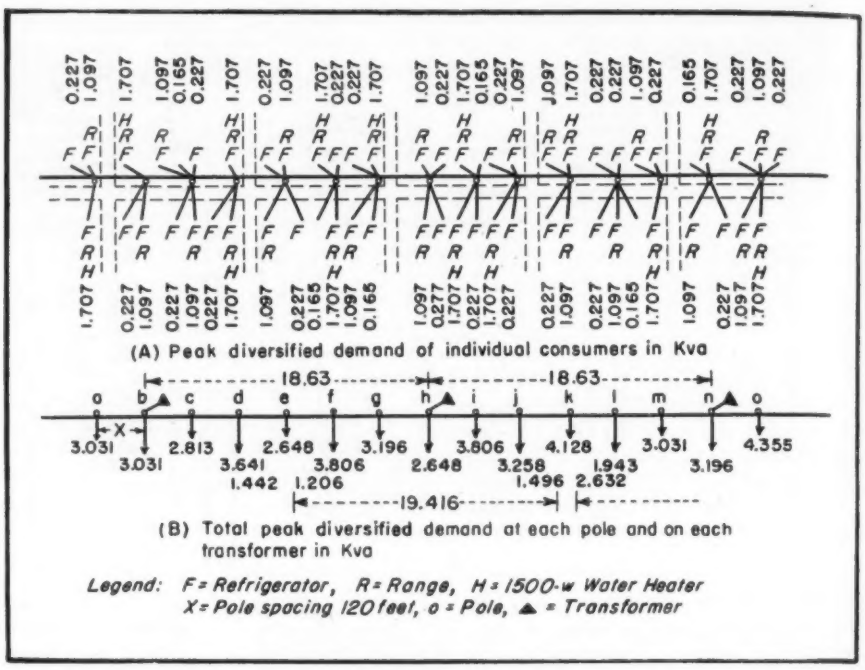


FIG 4—LOCATION OF TRANSFORMERS depends on the location of loads. A map showing poles, services and location of heavy appliances is necessary for accurate location of banked-secondary transformers

occurs. If this is inconvenient it can be measured at some other time and corrected by a proper factor. But if even this is impossible the sum of the individual diversified demands can be used.

The load imposed on a single secondary bank need only be limited by the capacity of the primary feeder supplying it. If an entire bank is to be switched to another feeder, during an emergency, the total load on a single bank should be limited to approximately 200 kva so that the emergency feeder will not be seriously unbalanced or overloaded. If the total peak demand of the banking area is appreciably more than 200 kva two or more banks should be used. The smallest bank should have at least three transformers to minimize the overloading on remaining units if one transformer is out of operation.

Individual Consumer Loads

Besides knowing the peak demand for the area, it is necessary to know how load is distributed. This requires knowledge of the number of consumers, their location, and the expected diversified peak demand of each consumer. Individual diversified demands can be estimated from curves* similar to Fig 2 if the number of individual consumers and the range, refrigerator, and water-heater saturation is known.

Ordinarily individual diversified demands are based on the total number of consumers to be supplied by the banked secondary. But if more than three transformers are to be banked, the individual diversified demands corresponding to the total number of consumers are too low because the diversity among all the individual demands is not completely realized in a large secondary bank.

The extent to which the diversity among loads in an area can be realized in a banked secondary depends on the number of transformers used, their impedance and the impedance between transformers. The error due to basing individual diversified demands on all the consumers, will be about 10% for banks requiring ten or more transformers, and less for smaller secondary banks. This discussion is based on individual diversified demands corresponding to the total number of consumers in the area considered. It will result in usable load values, but the margin of capacity for load growth is reduced by the extent of the error in the estimated individual diversified demands.

Individual peak demands for ranges, refrigerators, and miscellaneous appliances and lighting occur at different hours of the day. Since the range is the largest of the residential loads, it has the greatest influence on the time of day when simultaneous peak demand occurs. A range saturation of 5% insures that peak demand on distribution transformers will occur at the time of the range peak. Therefore curves of Fig 2 for the individual peak demands of the various appliances give that portion of the peak load which they contribute at the time of the range peak.

The use of this estimating data to determine the expected peak demand from residential loads is illustrated in Example 1.

Transformers with built-in secondary breakers, suitable for banking are available in 10, 15, 25, and 37.5-kva, single-phase ratings. The 10 and 15-kva sizes are generally used in areas where the loads are represented by the curves in Fig 2. The larger sizes cannot be estimated by these curves. Diversified demands of such loads must be determined by experience, judgment and measurements.

Capacity to Demand Ratio

It is generally economical to install less aggregate transformer capacity than the total peak demand since transformers have high thermal capacity for brief peak loads and will be overloaded only during short daily peak periods in one season of the year.

A ratio of transformer capacity to peak demand of 0.8 indicates that transformers are loaded to an average of 125% of rating under peak demand. Individual transformers may

* *Residential Loads, Diversities*, by C. E. Arvidson and L. D. Cronin, ELECTRICAL WORLD, October 21, 1939 and *Diversified Demand Method of Estimating Residential Distribution Transformer Loads*, by C. E. Arvidson, Edison Electric Institute Bulletin, October, 1940.

experience more or less than this average 125% load. Allowable voltage drop for typical overhead systems supplying residential loads is generally accepted as 2.5% in the transformer; 3% in the secondary main. On the basis of 125% average load on the transformers, (0.8 capacity-demand ratio) the percent regulation in the transformer is between 2.5 and 3.0% at 90% power factor. In many cases the regulation in the secondaries is less than 3% and transformer regulation can be increased accordingly by increased allowable peak load. This frequently allows load growth to increase the average peak demand on transformers in a secondary bank up to about 170% of rated capacity or until overload signal lights on transformers indicate approach of dangerous overloads.

From Fig 3 it can be estimated what the average percent load on transformers will be after a few years. Ratios tailored to individual requirements can be based on the number of years after installation for the load to reach 170% if the percent increase per year in peak demand is known.

Locating Transformers

The location of each consumer, and the individual consumer diversified demand must be known before transformers for a secondary bank can be located. These can be shown best on a scale map or drawing. The diversified demand for each type of equipment, at the time of the range peak, determines the diversified demand of the individual consumer, as shown in Example 2.

Individual consumer loads found in Example 2 are marked on Fig 4. Transformers are tentatively located along the secondary mains at equal intervals of load each equal to the average load per transformer as explained in Example 3 and shown in Fig 4. Load division among transformers is estimated by determining the zero-current point in each secondary-main section between adjacent transformers as in Example 3. The zero-current point is the location on a secondary main between two adjacent transformers where the sum of the kva-feet from one transformer equals the sum of kva-feet products from the second transformer. The zero point is found by trial and error.

EXAMPLE 1

Assume an area being considered for banking has 250 consumers each having lighting and miscellaneous appliances. The saturation is 52% for ranges, 92% for refrigerators, and 24% for water-heaters of the 1500-w, single-unit, "on-peak" type:

Equipment	No. Consumers	×	Diversified Peak Demand Per Consumer (Kva)	=	Total Diversified Demand (Kva)
Lighting & Misc. App.	250		0.165		41
Ranges (52%)	130		0.87		113
Refrigerators (92%)	230		0.062		14
Water-Heaters (24%)	60		0.61		37
					205

EXAMPLE 2

Assume the same number of consumers and saturation as in Example 1. The individual diversified demand for each type of equipment is shown in Example 1, but since each consumer will have one or more types of equipment, the individual-consumer diversified demand is tabulated below:

Number of Consumers and Equipment	Individual-Consumer Diversified Demand
20 consumers with lighting and miscellaneous appliances	0.165 kva each
100 consumers with lighting, miscellaneous appliances, and refrigerators	0.227 kva each
70 consumers with lighting, miscellaneous appliances, refrigerators and ranges	1.097 kva each
60 consumers with complete electric service including 1500-w, single-unit, "on-peak" water heaters	1.707 kva each

EXAMPLE 3

Assume the same data as given in previous examples. Fig 4 shows the consumer locations and loads for a portion of the whole area being considered. Eleven 15-kva transformers are required for a total load of 205 kva, based on a capacity-to-demand ration of 0.8. The average load per transformer is 18.63 kva. If a transformer is located arbitrarily at *b* and if half of the consumer load supplied from *b* is included, then 18.63 kva to the right will include 1.011 kva of the consumer load at *h*. A transformer is then located at *h* and the balance of the consumer load at *h* is included in the next 18.63-kva interval which locates the third transformer at *n*. This procedure is continued around the loop. If the intervals have been correctly counted, the last interval will be exactly equal to the average load per transformer. In the case of a line secondary bank, half of the average load on a transformer should be at each end of the line beyond the transformer locations.

Kva-feet products to right from pole *b*:

To pole *c*:	(2.813) × (120)	= 338 kva-feet
pole *d*:	(3.641) × (240)	= 874
pole *e*:	(1.442) × (360)	= 519
Sum		1731 kva-feet

Kva-feet products to left from pole *h*:

To pole *g*:	(3.196) × (120)	= 384 kva-feet
pole *f*:	(3.806) × (240)	= 913
pole *e*:	(1.206) × (360)	= 434
Sum		1731 kva-feet

By trial it is found that the 2.648-kva load at pole *e* must divide in the proportions 1.442 kva from the transformer at *b* and 1.206 kva from the transformer at *h* to give equal sums of kva-feet products in the two ends of the main section between the transformers. Similarly, 1.496 kva of the load at pole *k* is supplied from the left and 2.632 kva from the right. The sum of the loads between the zero-current point at *e* and that at *k* is 19.416 kva.

The sum of all the loads between adjacent zero-current points is the load on the corresponding transformer. This method is accurate if resulting transformer loads are equal. But even if unequal loading of the transformers is indicated the inequality of load will be less than the calculation indicates since the secondary ties tend to equalize the transformer loads.

It is desirable to have the transformer loads about equal. If the estimated loads of some transformers diverge from the average by 10% or more, or if some transformers have more than about 130% load, different locations should be considered. The zero-current point also indicates the load carried in the secondary main on each side of the transformer. Secondary-main loads should be reasonably uniform. It is usually difficult to keep the ratio of two secondary-main currents at every transformer below 1.5, but generally a ratio less than 2 can be obtained. The services from the transformer pole should be connected to the secondary-main section carrying the smaller load so that

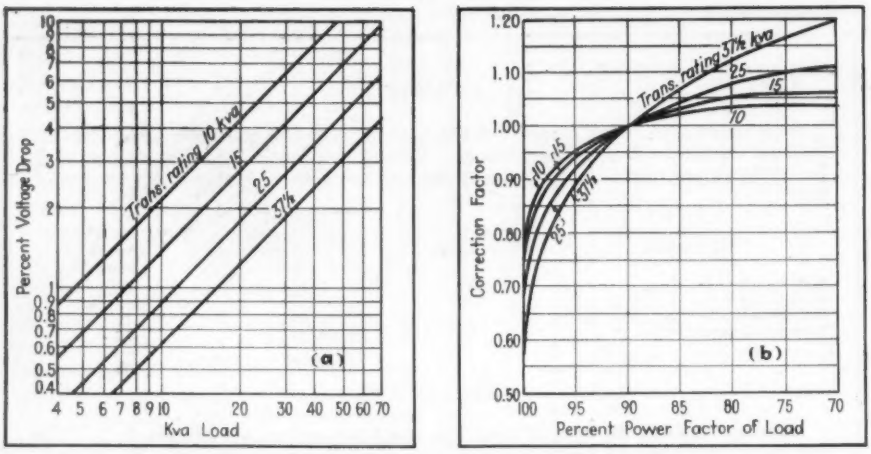
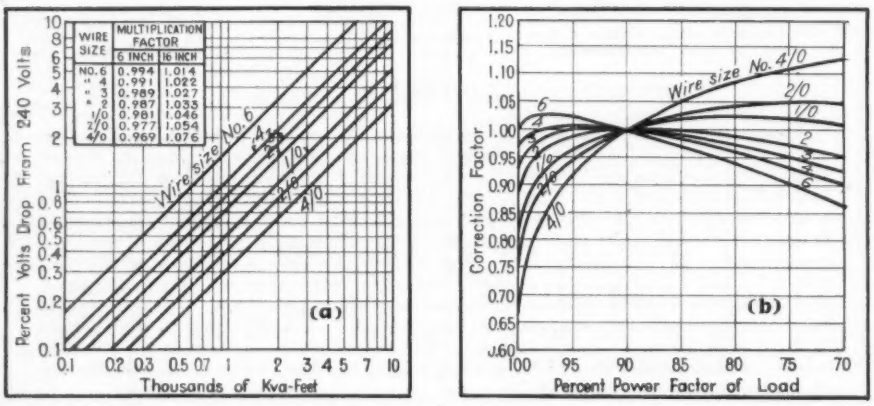


FIG 5—TRANSFORMER VOLTAGE DROP in percent of 240 v at 75 C and 90% power factor for four sizes of 2,400-120/240-v transformers are given in (a). Apply correction factors from (b) to voltage drop from (a) to obtain transformer voltage drop for other than 90% power factor



WIRE SIZE	MULTIPLICATION FACTOR	
	6 INCH	16 INCH
NO. 6	0.994	1.014
" 4	0.991	1.022
" 3	0.989	1.027
" 2	0.987	1.033
1/0	0.981	1.046
2/0	0.977	1.054
4/0	0.969	1.076

FIG 6—VOLTAGE DROP IN MAIN in percent of 240 v is given in (a) for stranded copper conductors, 8 in. spacing 65 C and 90% power factor. Multiplication factors from (b) applied to drop obtained from (a) correct for other than 8 in. spacings

the currents through the two breakers in the transformer will be nearly equal.

Conductor Size

A No. 2, TBWP copper secondary main satisfies reasonable electrical requirements in a banked-secondary system using 10, 15, 25, or 37.5-kva transformers. Reasonable flicker conditions will be provided by this size of wire for transformer spacings up to 1,000 ft with 10-kva transformers and for greater spacings with larger transformers. No. 2 copper provides for a voltage drop in the secondary main of about three volts where 25-kva transformers are no more than 800 ft apart and supply a uniformly-distributed load equal to 170% of the rated transformer capacity. The voltage drop is less than three volts where smaller transformers are used under similar conditions.

Ample carrying capacity is provided by No. 2 copper when transformer ratings are 10 to 25 kva and for most cases using 37.5-kva transformers. A No. 2 TBWP copper conductor has a carrying capacity equivalent to about 170% of the rated secondary current of a 25-kva transformer; about 114% that of a 37.5-kva transformer. It provides enough capacity for the emergency where a 25-kva transformer is out of operation between similar transformers and the normal peak load on each transformer is 170% of rating. But No. 2 secondary will not handle such an emergency with 37.5-kva transformers.

When 37.5-kva transformers replace smaller units on banked No. 2 copper secondaries, the transformers usually will be close enough so that voltage-drop and lamp-flicker conditions will be satisfactory. However, in a new residential development with high load density, where 37.5-kva transformers are proposed, a secondary main larger than No. 2 may be necessary because of carrying capacity, voltage drop, lamp flicker, or a combination of these factors.

Use of a No. 2 copper secondary main in a secondary bank will provide a reasonably economical design. A critical economic comparison may indicate a different size in some cases. The use of conductor smaller than No. 2 usually will require more transformer capacity than is needed with No. 2 for satisfactory flicker or voltage drop.

Voltage Drop in Secondary Mains

Voltage drop in the secondary main limits the distance between transformers. But this limitation generally occurs only in light-load-density areas.

Transformer voltage drop is shown in Fig 5(a) for 10, 15, 25 and 37½-kva transformers at 240 v and 90% power factor. The effect on transformer voltage drop of load power factors other than 90% is shown in Fig 5(b).

Secondary-main voltage drop is shown in Fig 6(a) for various conductor sizes based on 240 v and 90% power factor. The effect on secondary-main voltage drop due to load power factors other than 90% is shown in Fig 6(b).

The conditions shown in Table I were computed for a maximum voltage drop of 3% in the secondary mains. However, uniform loading along the secondary mains was assumed for computing the maximum tolerable distance between transformers. Also the total load on the secondary main section between transformers was assumed to be 170% of the capacity of one of the transformers. In a secondary bank consisting of equal, uniformly-loaded sections, these assumptions would mean that all the transformers would be loaded to 170% of rated capacity and additional capacity should be added. Therefore, the spacings shown in Table I represent limits at the end of a load-growth period rather than at the time of installing transformers.

The greatest voltage drop experienced by any load occurs at the zero-current point in the section of secondary main where the greatest kva-feet product is computed. This drop is the sum of transformer and secondary-main drops. Regulation of the transformer at *h* in Fig 4 is 2.7%

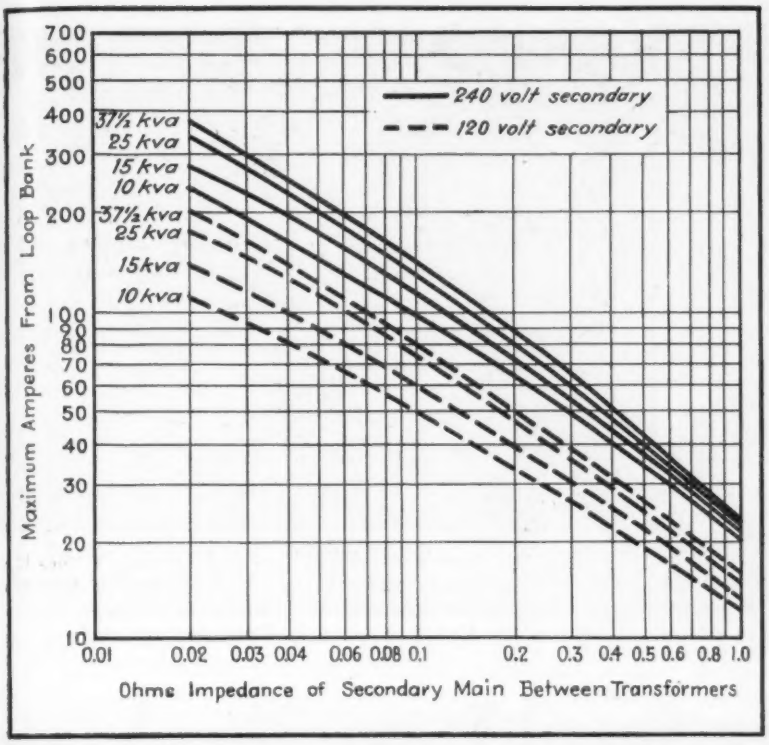


FIG 7—MAXIMUM ABRUPT CURRENTS from loop-type banked secondaries with 2.5% or less voltage dip. Values correspond to secondary-main impedances between transformers. Curves based on identical equally spaced transformers

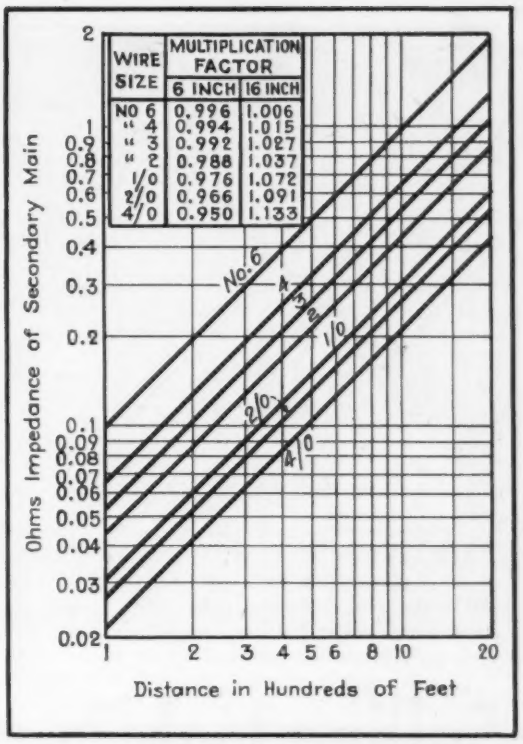


FIG 8—SECONDARY-MAIN IMPEDANCE between transformers for various transformer spacings and conductor sizes on 8-in. spacing. Apply proper multiplier if spacing is other than 8 in.

for the calculated load of 19.416 kva. Secondary-main voltage drop from *h* to *e* is 1.3% as shown previously. Thus the total drop at point *e* is 4.0%. Since there is a choice of two routes to each zero-current point generally it is more conservative to start from the more heavily loaded transformer.

Lamp Flicker

The reduction of lamp flicker due to motor starting currents and other abrupt loads is an important advantage of secondary banking. It results from the sharing of this load by two or more transformers.

A voltage dip of 2.5% is generally considered to be the maximum that can be tolerated on secondaries serving residential consumers. This is based on a non-cyclic voltage dip occurring not more than once a minute.

The maximum permissible current that can be drawn by an abrupt load, without exceeding the tolerable voltage dip, is greater when the secondary-main impedance between transformers is small. Flicker-voltage requirements are thus directly dependent on combinations of distances between transformers, conductor sizes and spacings, and transformer sizes. Currents that can be drawn from a secondary bank without exceeding a 2.5% voltage dip are shown in Fig 7 plotted against secondary-main impedances between transformers. The relationship between impedance and length of secondary mains between transformers is shown in Fig 8.

Fig 7 also shows the maximum allowable main impedance between transformers to permit starting currents of a specific residential appliance without undue voltage dip, when the appliance is midway between transformers. For example, assume that a loop-type bank must permit an inrush current of 20 amp at 120 v without causing more than a 3-v dip. Fig 7 shows that the secondary impedance between transformers must not be more than 0.45 ohm for 10-kva transformers, and higher values for bigger transformers, where the motor is located midway between transformers. For the 20-amp, 120-v example and secondaries of No. 6 stranded wire and 8-inch spacing, the distance between 10-kva transformers should not be more than 450 feet. The distance between transformers can be greater if bigger conductors and larger transformers are used. The tolerable distances between transformers for the conditions assumed in this example are shown in Table II.

Voltage dip that occurs for a given starting current in a system varies with the power factor of the current. The maximum dip occurs when the power factor numerically equals the ratio of resistance to impedance in the system. For typical appliance motors, the starting-current power factor ranges between 80 and 85%. Power factors in this range result in the maximum possible voltage dip for a given inrush current in many actual systems. Maximum starting-current limits shown in Fig 7 and Table II are calculated on this basis. When inrush currents have power factors other than 80 to 85%, these maximum-current curves give values that are slightly low but this is on the conservative side.

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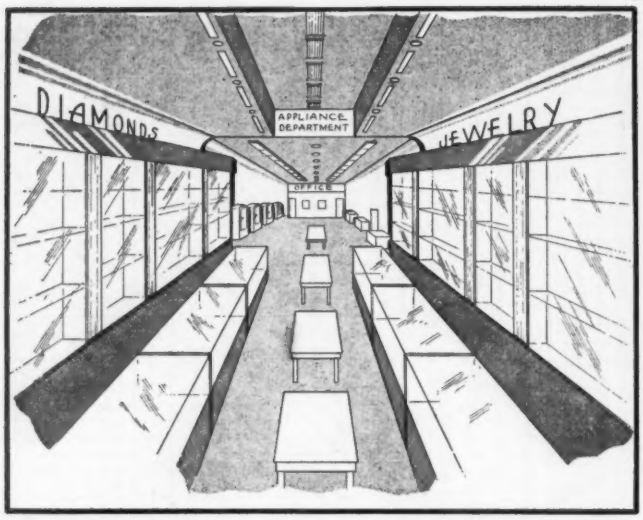

FIRST SKETCH AND FINAL JOB—Proof that there are profitable lighting loads in small town stores is established in the Al Wasley Jewelry Store, Plymouth, Pa., (16,000 pop). Conceived as in the sketch at left, final installation involved lighting load of 20.8 kw and monthly use of 5,986 kwhr. The complete store layout, including angled wall cases and feature display in rear, was part of utility lighting recommendations made to customer. Installation won 2nd prize in Augustus D. Curtis Award contest

Selling Lighting to Small Town Merchants

Eight rules for the lighting specialist interested in helping the small town merchant are laid down by one who has operated a one-man commercial lighting department serving a dozen small towns in eastern Pennsylvania

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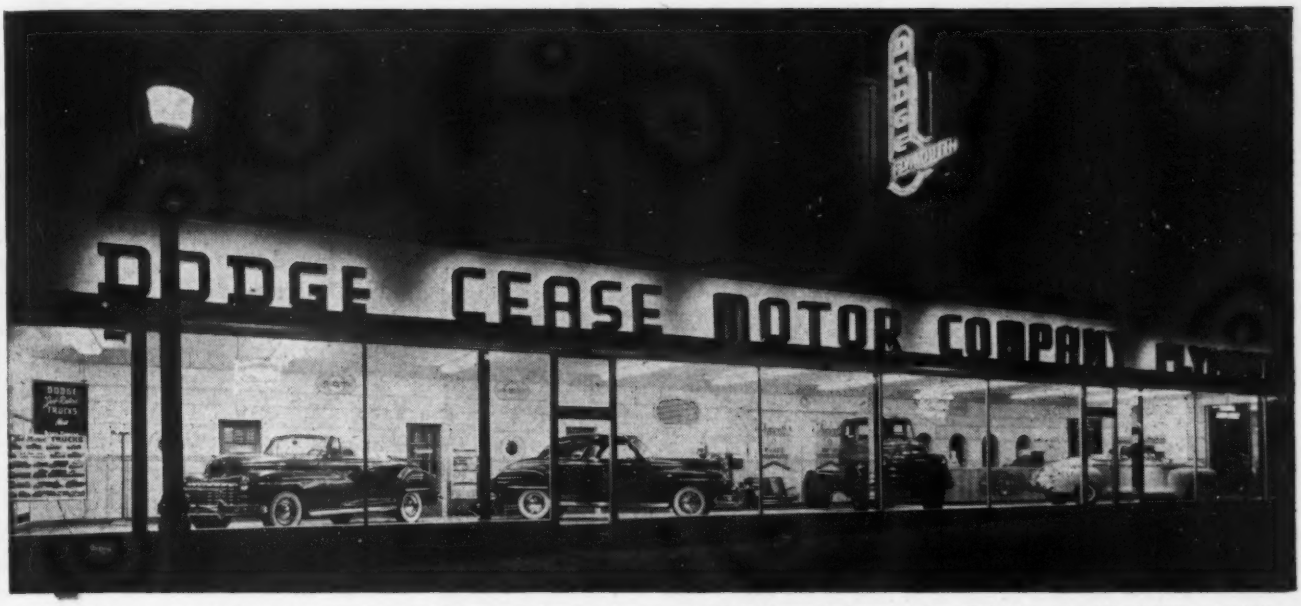
CUSTOMER for customer, there is just as much potential commercial lighting business in small towns as in big cities. But it takes a different kind of selling to develop it. This article will try to set down a sales philosophy that has grown out of ten years experience operating a one man commercial lighting department in a utility serving about 4,000 commercial customers in 12 small towns and one city of 25,000 people. In its essence, this philosophy boils down to a list of eight ways to make friends with the small town merchant. They are set down here one good turn after another.

1. HELP HIM DREAM—Although he may dream of owning the "best store on Main Street", the average small town business man is condemned to dream and plan without the help of hired experts on store modernization. Without help, that is, *unless* his utility lighting specialist interests himself in the problems of decorating, store front design, fixture selection and store arrangement to the extent of offering helpful suggestions. The lighting specialist has advantage of seeing a store from the customer's point of view and visualizing possibilities that the owner may not see. By imparting what he sees to the store owner, "pipe dreams" can be directed into practical channels. More often than not participation in the early "dream stage" of the project will offer opportunities to show how lighting can be used as the central element of the modernization that gives unity and cohesion to the entire project.

2. PRESENT A PLAN—A carefully-conceived lighting plan with a complete lighting layout and equipment specification builds customer confidence in the lighting adviser and respect for the part lighting plays in store modernization. A small store keeper untrained in visualization has understandable difficulty picturing how the finished installation will look without a scale drawing to orient him. The writer has found 2½ to 3 hours time invested in making a neat engineering drawing of professional quality not only clears up questions fast but builds customer respect for the importance of his lighting installation. It pays to prepare a sketch for even the smallest jobs: Don't insult him with an "off the cuff" free-hand pencil sketch on quadrature ruled paper or the back of an old envelope, no matter how small the job.

3. GIVE HIM A GOAL—Small town stores aren't often modernized throughout in one fell swoop. The finished job, more often than not, is a dream that materializes step by step when, as, and if savings accumulate. The astute and neighborly lighting specialist will see to it that his customer proceeds step-by-step toward a carefully thought-out and visualized



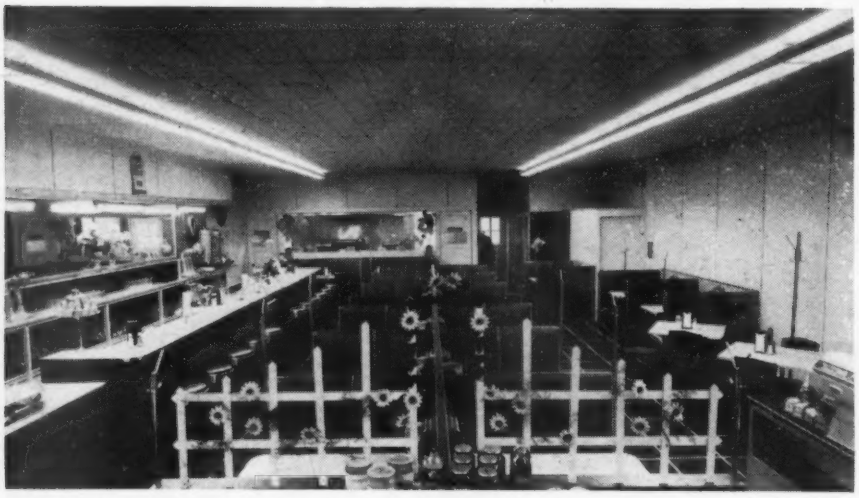
AUTOMOBILE SALESROOM of Cease Motor Co, Nanticoke, Pa., has 75 fc of louvered general lighting plus recessed interior spot lighting and show window lighting. Outside lighting includes flashing two-color neon sign and silhouette display

ED'S MARKET, a small grocery in Kingston, Pa., is typical store profiting from the services of utility lighting specialists. Illumination from continuous-run louvered fixtures is 30 fc. Case lighting and concealed show window lighting was also used

goal; that his interest in attainment of that goal does not lapse in the interval before completion; and that the several stages in the plan are carefully laid down at the beginning. For customers whose thoughts on modernization are at loose ends, such a project plan will provide tangible suggestions to consolidate thinking. For example: A new interior lighting scheme coupled with redecoration and fixture modernization takes on purpose and direction when visualized as a step toward an all-glass store front in which the entire store interior becomes a show window. A perspective sketch of the store interior seen through the glass store front will keep the goal fresh in the merchant's mind although several years may elapse before the goal is reached.

4. HELP HIM GROW—In a small town, good lighting can be the "better mouse trap" that will bring the world to your customer's store. Skillful attraction lighting and atmosphere lighting plus astute merchandising can literally draw store traffic down the street and into a particular store. Moreover, lighting can be instrumental in creating character in a store that will develop business volume to a level above what the town alone can produce. This was actually accomplished by a jewelry and appliance store in Plymouth, Pa. that is now

SMALL TOWN INDUSTRY as well as stores and commercial establishments can profit from the services of utility lighting specialists. The Emkay Mfg Co, above, at Wyoming, Pa., learned this when they installed continuous run single lamp channel with polished parabolic reflectors and secured 100 fc of light at the needle point, plus overhead lighting



KELLY'S RESTAURANT at Kingston secures 24 fc general illumination from continuous run louvered fixtures. Spot lighting is used at the entrance; special lighting at the back bar

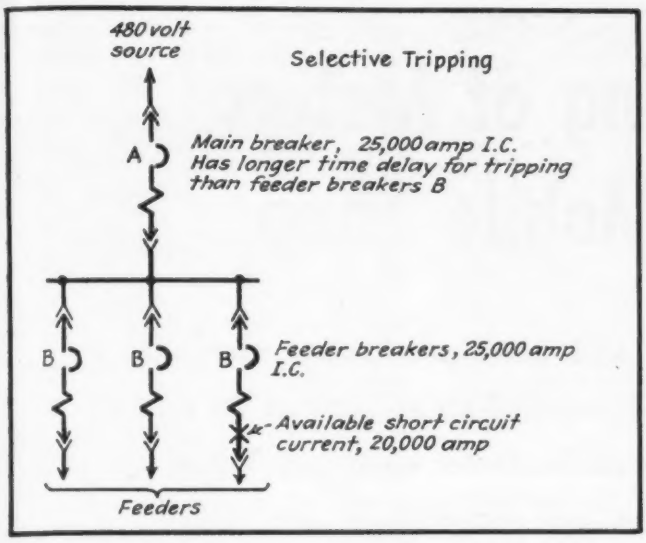
drawing business from a city of 85,000 three miles away, the result of a complete modernization in which lighting played a vital role. In this instance revenue jumped from "thousands" to a fraction of a million dollars annually.

5. DON'T OVERSELL HIM—In small towns, particularly, the amount and kind of lighting installed should be consistent with the merchant's ability to use it *profitably*. If, for any reason, more light is installed than is warranted by the store location, its function in the community or its potential volume of business, the customer will sooner or later use only a portion of it and spoil the entire effect of a well-lighted store. But what is more serious—the customer will lose confidence not only in the lighting specialist but also in lighting itself, and the danger is that he will communicate his feelings to other store owners. In the final analysis the value of a lighting specialist to his company depends on his ability to command the confidence and respect of the family of merchants he serves and *not* his ability to sell every last watt the traffic will bear.

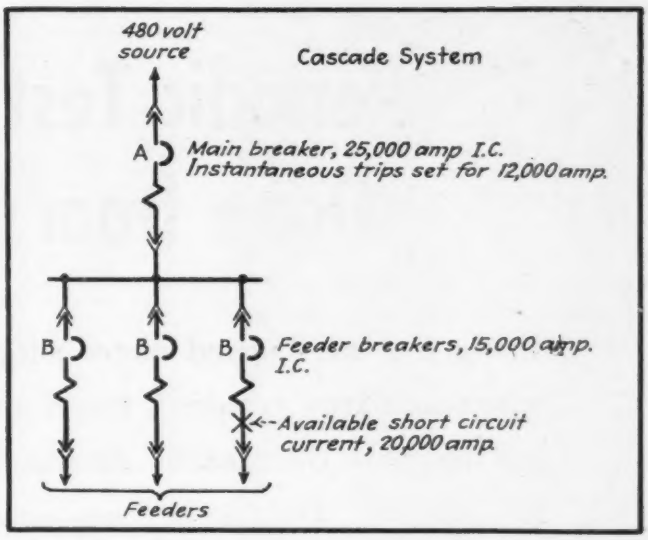
6. DON'T FORGET HIM — Even though there is no immediate chance of selling him additional lighting don't stop calling when the job is done. There are still many services you should render that will help the merchant get the most out of his new lighting. There is often a tendency to turn lights off during daytime hours under the impression that incidental daylight is enough. This practice needs correction. Few store keepers appreciate the importance of fixture maintenance. Take a light meter in occasionally and show him that he is losing both light and money by improper fixture maintenance or too infrequent lamp replacement. Occasional new ideas in merchandising built around the use of light will keep up his interest, and develop his understanding of light as a new selling tool.

7. LET HIM SELL LIGHTING FOR YOU—Nothing in a small town travels faster than gossip. Fortunate indeed is the lighting specialist who can make it work for him. A proud merchant in a well lighted small town store can spread the gospel of good lighting through Main Street and establish the reputation of a lighting representative faster than any other medium. Bring other merchants from out of town to inspect the new store; then let the owner do the talking. Drop in on the proud owner periodically; chances are he has been visited by a number of merchants who are planning changes and dropped in to see his store to get some ideas. In the past ten years the bulk of the productive leads on new commercial lighting prospects have been gleaned through just such call backs on satisfied customers.

8. COOPERATE—Effective promotion of commercial lighting in small towns (or large) depends on the close cooperation of all who deal with the customer. It is an important duty of the lighting specialist serving small towns to see to it that all groups who contact the customer are sold on good lighting and use the lighting story in their presentations. Close cooperation among store front and display case manufacturers, interior decorators, distributors and electrical contractors will not only lead to an integrated job for the customer but also is productive of mutually useful leads on prospective new business. The small town electrical contractor, particularly, will appreciate the lighting specialists help with special problems. In return the electrical contractor working with the lighting specialist can do a great deal to develop "fixture orders" into a "planned lighting job", because in many instances the contractor is the one to whom the customer goes with his lighting problems.



SELECTIVE TRIPPING SYSTEM lets feeder air circuit breakers interrupt all fault currents on feeders. Main air circuit breaker opens only for bus faults or because of failure of feeder breaker



CASCADE SYSTEM uses main air circuit breaker to assist feeder breaker interrupt all faults in excess of 80% of feeder breakers interrupting capacity

Selective vs Cascade Tripping

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In recent years, draw-out air circuit breaker switchgear has been widely applied in industry for power distribution at 600 v and less. Applications range from small industrial plants to large power stations. As a result, service requirements of the circuits involved also vary greatly. For example, a small machine shop might be adequately served if the distribution system were such that the relatively few major short circuits which might occur, caused a complete shutdown of power facilities for 10 or 15 minutes. On the other hand, a large generation station would be poorly served if the distribution system allowed a total station auxiliary power outage of as much as 10 seconds except in an extreme emergency.

The basic system that meets all requirements of the entire range of applications is the selective tripping system shown. In this system, both the main and feeder breakers *A* and *B* have interrupting and short-time ratings at least equal to the maximum available short circuit current. Also, the time-delay trips on the main breaker are so coordinated with the trips on the feeder breakers that all feeder faults are cleared by the feeder breaker only. The main breaker trips only in the event of bus faults or the failure of the feeder breaker to trip. Therefore, a feeder fault always is cleared without interruption of service on other feeders, as shown in the circuit schematic.

Where service continuity requirements are not severe, the selective tripping system often is not economically justifiable. The more costly full interrupting rating feeder breakers may be out of proportion to the importance of the loads served. For such applications, the less expensive cascade system can be utilized.

The cascade system uses one breaker with an interrupting rating at least equal to the available short circuit current, to assist second breaker of lesser interrupting rating to interrupt currents in excess of the interrupting rating of the second breaker.

In the cascade system shown, instantaneous trips of the main breaker *A* are coordinated with the interrupting rating of the feeder breakers *B*. For all feeder faults in excess of 80% of the interrupting rating of the feeder breaker the main breaker will trip as well as the feeder breaker. Thus for fault currents in excess of 12,000 amp both the main and feeder breaker open. Lesser fault currents are interrupted by the feeder breaker alone.

But the cascade system has one very important limitation. Although it is selective for faults up to 80% of the interrupting rating of the feeder breaker, a short circuit above that value on any feeder will, by tripping the main breaker, remove power from all feeders served by the bus. Another limitation is that after interrupting the maximum available short circuit current with the help of the main breaker, the feeder breaker may not be in condition to again interrupt its full rating without inspection and maintenance. This may result in considerable delay in restoring service to a faulted feeder.

Compared to the cascade system, selective tripping is preferable for all circuits supplying essential service, such as boiler auxiliaries in large generating stations or continuous industrial processes such as rayon mills. In such applications, the entire saving by the use of the cascade system could be offset by the cost of a single unnecessary shutdown of operations caused by the loss of power on the bus resulting from the main breaker assisting in the interruption of a heavy fault on a single feeder.

Periodic Testing of Meters Done from Mobile Shop

Using a trailer-housed meter shop and mass production methods, a seven-man crew repaired, tested and installed an average of 70 meters per day for 30 months during periodic meter check on Texas utility system. Details of equipment and procedures are described

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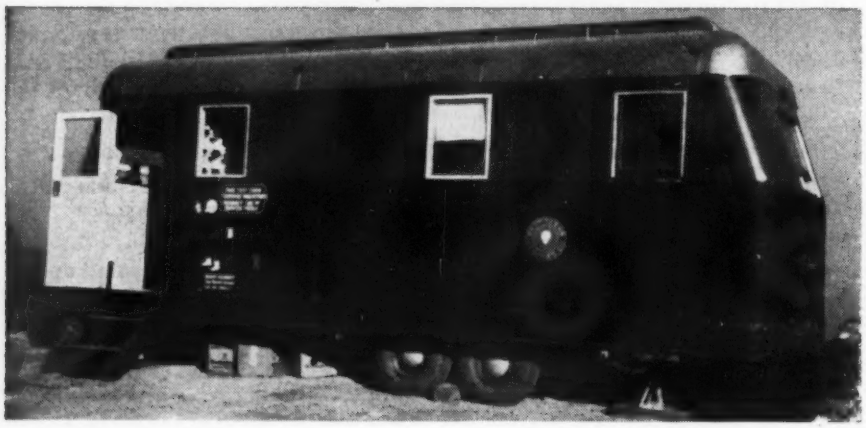
AN AVERAGE EXPENDITURE of 1.203 man hours and a cost of $1.372 to check, test and install a single watthour meter was incurred by this company in the last periodic test. These low costs are only part of the benefits that have resulted from a system-wide processing of meters by the newly developed technique.

This technique utilizes the change-out method. However, instead of returning the meters to the shop, the shop was carried to the meters. All work was done in the field.

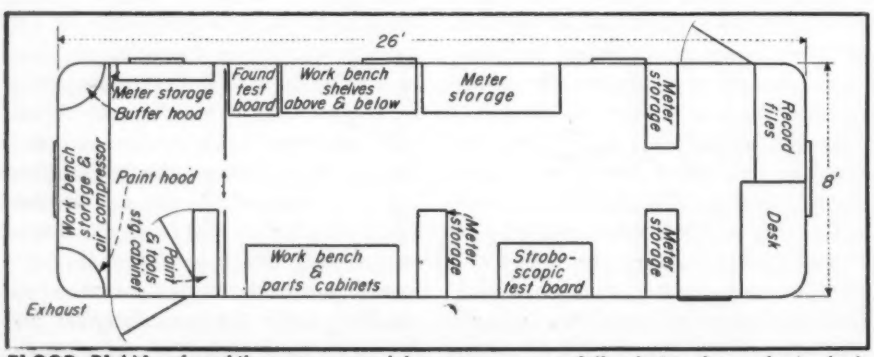
In all 45,447 meters were processed by a 7-man crew in a 30-month period. In addition to repairing, testing, and installing:

1. 6,386 overloaded meters were found and replaced with units of larger capacity.
2. 8,159 meters were found "loaded to capacity"—larger capacity units installed.
3. 8,173 cases of overmetering were detected—lower capacity units installed.
4. 352 cases of tampering were detected.
5. 2,935 cases of grounded meters were found and rectified.

The new field testing procedure is built around a mobile meter shop housed in a conventional house trailer 26 ft long, 8 ft wide and 12 ft high, that is moved into town and set in a single location. Meters are changed out and brought to the trailer shop by 2 men in a pick-up truck. After all meters are brought in, checked and repaired, the complete unit moves to the next location.



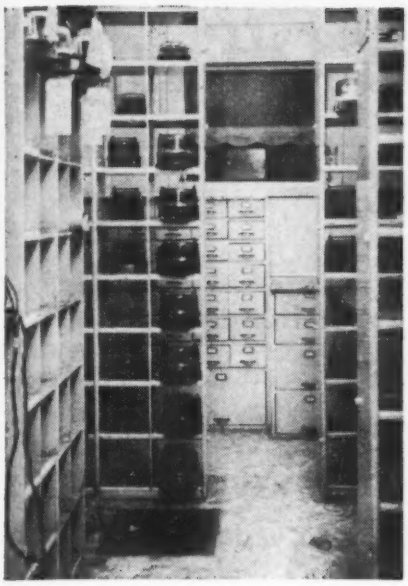
METER SHOP TRAILER sets up for business in any vacant lot where secondary service is available. Meters can be completely checked and repaired



FLOOR PLAN of mobile meter test laboratory was carefully designed to obtain high productivity with minimum of space

Shop Equipment

Within the trailer are two combination work benches, storage cabinets for parts, racks for 400 meters, a paint bench with a buffer, exhaust fans to remove dust and paint fumes, turn table, air compressor, and storage space for glass covers. Sliding doors shut the paint compartment off from the rest of the shop. Also included are a specially designed conventional test board for use with a rotating standard, a combination stroboscopic and automatic test board as well as a desk and cabinet for



AMPLE ROOM for equipment and for working is provided in the interior of the trailer. Space for meter storage, meter record files and desk is provided in the front part of the shop

meter records. The shop has semi-indirect lighting, an electric heating system in the floor, and an evaporative cooling system. The pick-up truck is equipped with a special bed with individual bins for 96 single phase meters and 12 polyphase meters.

Two meter changers started out each day with a load of tested meters. At the customer's premises, one contacted the customer, explained the mission and asked permission to interrupt the service for a few minutes. Meanwhile, the other was checking the service and installation and getting ready to change out the old meter and install a tested one. The actual changing of meters usually took about three minutes. Service was usually interrupted less than one minute. At this time, checks were made for tampering, hot wire in proper place in the meter, voltage, wiring, load side grounds, hot neutrals, etc.

A photograph was made of the dial face of the removed meter. This photograph was developed in the shop and clipped to the original copy of the change order. Since all installed meters were set reading zero, it was not necessary to photograph them. The print served as a double-check on the kwhr reading of the meter.

Old meters on the pick-up truck were unloaded into the meter shop once or twice a day. Since several towns were usually worked from one

Complete Cost of Periodic Meter Test

Total Units 45,447

Item	Total Cost	Cost Per Meter	Percent of Total Cost
Repair Parts	$25,699.96	$0.561	40.9
Total Labor Cost (Payroll and Expenses)	29,954.67	0.654	47.8
Car Expenses	2,104.53	0.046	3.4
Equipment Cost	3,617.54	0.079	5.6
Stationery & Misc.	1,469.07	0.032	2.3
TOTAL	$62,855.77	$1,372	100.0

MAN HOURS PER METER

Supv.- Records & Misc.	Found Test	Left Test	Repair	Removing & Setting	Total
.130	.0418	.121	.288	.246	1.203

location, it was often necessary for the pick-up crew to work all day without unloading the old meters and restocking with tested ones.

Procedure in Shop

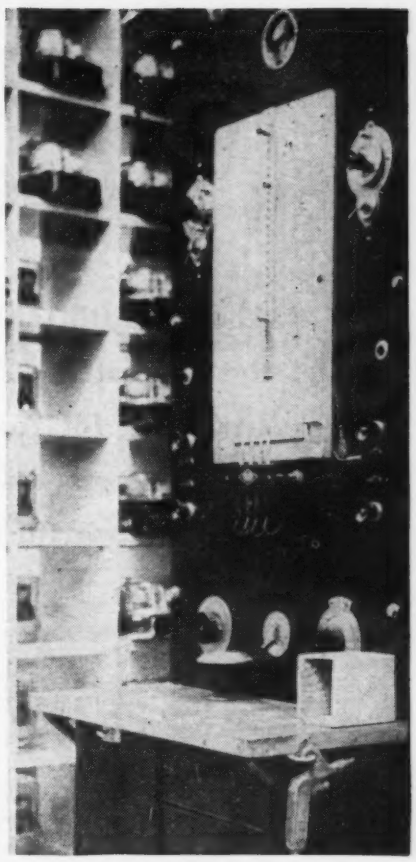
Rigid adherence to procedure and detail in processing meters was responsible for the results. Upon entering the shop each meter was given a numbered repair tag listing all essential data on that meter. Each was then given an "as found" test by the general repairman using the conventional test board and rotating standard. The usual ten revolutions on full load and two on light were used, converted to a "percentage revolution" basis, and recorded on tag. Meters needing painting went to the paint bench; others went to the rack ready for repair.

The general repairman also painted meters, washed and regasketed glass covers, cleaned and repainted register faces, and stamped discs with stroboscopic markings. Usually meters were painted once a day, register faces once a week, and stamped discs every two days. The "as found" tests usually took about three hours per day.

Actual meter repair was done by two men who worked on groups of five meters of similar type and size at one time. The first repairman removed the covers, checked seals for tampering, checked the terminals, and

Materials Used per One-Thousand Meters

Meters painted	160
Jewels replaced	450
Series or Shunt coils replaced	30
Dials replaced	300
Discs replaced	10
Magnets replaced	10
Terminal assemblies replaced	20
Wing nuts replaced	400
Sealing bars installed	850
Temp compensators installed	450
Metal covers replaced by glass	230



STROBOSCOPIC BOARD where final tests are made is designed to require a minimum of space and is located to take advantage of storage and shelf areas

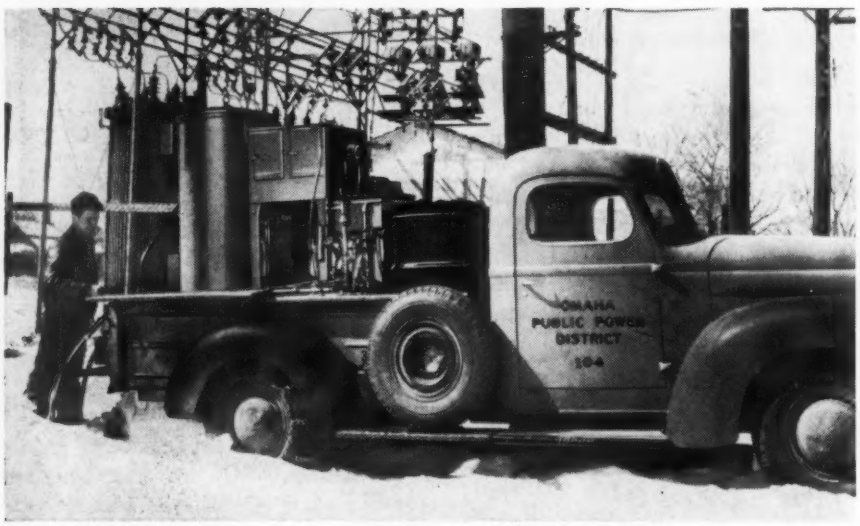
gave each a high potential test. Registers, magnets, jewels, and discs were then removed. Discs were examined for scratches indicating tampering. They were further disassembled, if necessary, to examine the coils carefully for damage due to overloads, lightning, water, etc. All screws and electrical connections were tightened; dust and iron filings were blown from all parts. Removed jewels were set aside for cleaning and miscropic inspection. Removed discs were set aside for stamping with stroboscopic marks. The first repairman then started the reassembly of the group of meters, using new or checked jewels and "stamped" discs. New pivots were used in all General Electric and Sangamo meters. New steel balls were used in all Westinghouse meters. Temperature compensators were placed on all meters not previously compensated. Removed parts were always put back on the SAME meter unless damaged.

The second repairman inspected each register; put a new dial face

(*Continued on page* 145)

Insulating Oil Purification Offers Operating Economies

About $4,000,000 could be saved this year by reconditioning the estimated 12,000,000 gallons of insulating oil considered unfit for further service and earmarked for removal from transformers and switches. Authors examine basic systems for oil purification and possible savings now available



ADSORBENT PURIFIER and blotter press mounted on truck for field use

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Manager of Research and Development
Honan-Crane Corp*
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INSULATION OIL purification has become a major program among utilities conscious of what it means today in preventive maintenance and immediate savings.

The potential savings to the entire industry from this source are noteworthy. It has been estimated that over twelve million gallons of oil will be purchased this year for replacement purposes in transformers and switches. If reconditioning-cost was one-third the price of new oil, savings close to $4,000,000 could be realized.

Direct savings that are available to individual companies through reduced oil purchases resulting from the conditioning and re-use of oil ready for discard can be estimated from the chart (Fig 1).

In addition to such immediate savings, other benefits to be realized from regular oil conditioning are:

1. REDUCED MAINTENANCE — Periodic oil conditioning will essentially eliminate sludging in transformers and the subsequent costly cleaning that it makes necessary. Reduced deterioration of fabric insulation may be expected. Excessive build up of core moisture may be prevented.

2. EQUIPMENT FAILURES—Elimination of sludge deposits from the majority of transformers should result in fewer equipment failures due to overheating and burnouts along sludged surfaces.

3. LOWER ELECTRIC LOSSES—Regular oil conditioning will help maintain power factor percentage at a lower level; also will maintain lower average operating temperatures which reduce electric losses.

4. LONGER EQUIPMENT LIFE—Deteriorated oil attacks insulation; hence shortens equipment life. Corrosive acids in deteriorated oil also attack covers.

However, the reconditioning of oil that is already unsuitable for further service is not the real answer to oil deterioration and the attendant break-

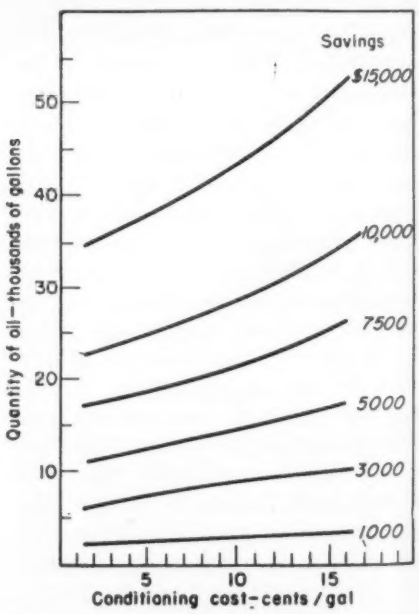


FIG 1—ESTIMATED SAVINGS from oil reclamation can be found from this chart, which is based on reconditioned oil life equivalent to new oil. Since this premise may or may not be the case, some allowance may be necessary. New oil cost is figured 44½¢ per gal. When stability of reconditioned oil is inadequate an inhibitor is suggested

* Subsidiary of Houdaille-Hershey Corp

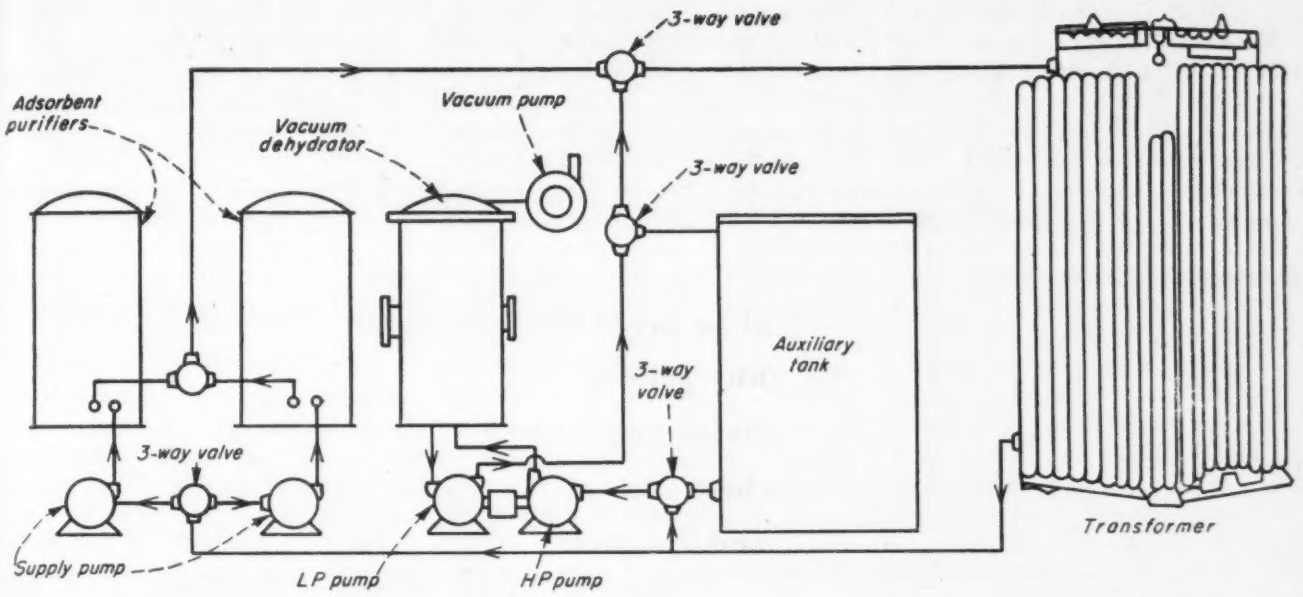


FIG 2—NEW PURIFICATION SYSTEM combines adsorbent purifiers with a vacuum dehydrator. In operation oil circulates through purifier till conditioning is complete and then is directed to auxiliary tank and finally pumped through vacuum dehydrator back to the transformer. Purifiers can be operated individually for single or two stage treatment or in parallel for full-flow capacity. Vacuum dehydrator may be used simultaneously with purifiers if separate return to transformer is installed. Auxiliary tank may be omitted and dehydrator operated directly from transformer. Portable use may be made of this system because of compact design

downs, electric losses and decreased efficiency. The answer to most of the troubles arising out of oil deterioration lies in regular, periodic conditioning of oil in service.

Selecting Proper Equipment

Selecting the basic oil purification method, the equipment and the adsorbent is the first step in setting up an oil conditioning program.

Advantages are to be found for each type of purification equipment. Too often important factors may be overlooked simply because they are not readily apparent. It is, therefore, necessary to delve into all the ramifications and evaluate a proposed conditioning system in the light of the particular system requirements. Here is a type of inquiry that might well be followed:

I. Will this equipment do the job?
- A. Demonstration test.
- B. Testimonials of other users.
- C. Typical operating data.

II. Is it better than other methods?

A. Performance comparison — quality of conditioned oil on basis of chemical and physical tests.

B. Operational — operating attention, treatment time involved; technical skill required; ease of operating; necessity for chemical control tests.

C. Functional—safeguards against chemical reaction products; high-temperature oxidation; migration of filter medium through outlet.

D. Other considerations—

1. Reliability — how "fool-proof", well engineered, and simple to operate.

2. Adaptability—for present and future needs; to treatment of oils in various stages of deterioration.

3. Flexibility—adaptability to central location or field use; suitability for handling Askarels (synthetic insulating fluid).

4. Service history — maintenance cost; east of servicing.

5. Adsorbent evaluation — ability to remove various oxidation products; cost analysis; quality of conditioned oil (on basis of complete chemical and physical tests).

III. Will the treatment cost be economical?

A. Operating cost analysis—covering adsorbent; chemicals; blotter paper; power; labor; transportation; fixed charges; oil loss, etc.

B. Adsorbent evaluation—cost per gallon of conditioned oil for various deteriorated oil stages; uniformity; reliability of source of supply.

IV. What are the over-all economic aspects?

A. Future requirements — provision for expansion where likely to be required; evaluation of investment from standpoint of possible diminishing usage where initial "reclaiming" program is large.

B. Preventive maintenance—ample capacity to condition oil in service within one or two years; adequate facilities for continued conditioning thereafter on an economical basis.

C. Savings — estimated over-all savings per year.

Conditioning Equipment Types

Types of conditioning equipment that have been used by the industry are described and oriented with respect to their primary utility in the following summary:

1. FILTRATION UNITS—This group includes filter presses, wire or strainer type units, generally used to remove suspended solids and so raise dielectric strength of the oil. Filter aid may be used to increase filter runs when sediment is appreciable. Adsorbent clay is sometimes added to an oil batch and thoroughly mixed at 150-200 F before filtering.

2. CENTRIFUGES—Mainly used in central treating plants where gross water and dirt should be removed before final dehydration to raise dielectric strength. Also used to remove water and fine clay following alkali and water wash processing in chemical treating plant.

3. CHEMICAL TREATMENT PLANTS —These usually include an alkali or acid treating tank, clay contact tank, centrifuge, filter press, pump and auxiliaries. Acid treatment followed by alkali also has been used. This treatment is basically suited to reclaiming oils of high neutralization number where adsorbent treatment alone probably would be too costly. While excellent results are obtainable, chemical treatment is not suited for many installations because of high first cost, technical personnel and know-how required, and insufficient oil to jutify its existence after the initial volume is conditioned. It requires intelligent operation and chemical control.

4. RECLAIMERS—Of limited utility for insulating oil application except in cases involving relatively small volumes of badly contaminated oil where chemical or adsorbent treatment is not applicable. Flow rates are usually low due to limited heater size. If heater area is reduced, higher temperatures must be used and "cracking" may occur at the interface. The heating load is considerable—125,000 Btu's for 100 F temperature rise in a 300 gph unit. Size and weight of many types preclude portable application.

The removal of light ends by vaporization under a vacuum at about 250 F is the primary reason that they are classified as reclaimers while adsorbent purifiers are not so classified.

5. ADSORBENT UNITS — Generally considered where regular conditioning program is planned because most units are portable. May be used for central station application or field use to condition oil with or without removing electric equipment from service. A low cost granular adsorbent is used. Results are good although when oil is badly deteriorated reconditioning cost becomes excessive. Some dehydration equipment, such as a blotter press or vacuum dehydrator, is usually included to follow adsorbent treatment. Principle advantage of adsorbent units lies in flexibility and simplicity since complicated controls are not required.

6. THERMOSYPHONS — Such units are being made available by at least one manufacturer as standard equipment on new transformers. Their function is to prevent excessive acidity and sludging. With oils that may oxidize at a rapid rate, following their induction period (as accelerated tests indicate on the new oxidation-inhibited oils) the use of an adsorbent unit to arrest the formation of sludge until inspection time would seem to be desirable. Service life of oxidation inhibited oils will in most cases exceed that of conventionally refined oils on the basis of accelerated oxidation tests.

Newest development in insulating oil purification equipment—combines adsorbent purifiers with a vacuum dehydrator. The system shown schematically in Fig 2 offers a number of features:

1. High flow capacity (600 gph), reduces conditioning time.

2. Dual adsorbent units that can be operated singly or in parallel to meet varying capacity needs.

3. Separate vacuum dehydration and degasification system provides—

(a) Clean oil to spray nozzles.

(b) Lower cost unit—higher capacity is required when operating in series with purifiers.

(c) Dehydration of purified oil while system is completing purification or operating on a second batch.

4. Arrangement for counter-flow operation conserves adsorbent.

5. Compact design for portable use.

6. Central controls simplify operation.

The more flexible the oil conditioning system, the greater its adaptability to the utilities' varying requirements. As a consequence, considerable time may be saved since conditioning can generally be completed more quickly with less down time. If there are a number of large transformer units involving oil volumes of 1,500 gal or more, a higher capacity unit should be employed for economical conditioning. Otherwise, labor costs will be excessive and conditioning times of long duration.

A unit of this type is shown in an accompanying picture. It is a multiple type purifier. Adsorbent is charged into containers of the basket type which are removable for ease of reloading.

TABLE I—Activated And Natural Adsorbents Compared

ACID ADSORPTION

	Activated Clay	Natural Clay
Original	0.62	0.62
After 5 min.	0.17	0.34
After 15 min.	0.17	0.20
After 30 min.	0.17	0.14
Percent Acid Adsorption	72.6%	77.4%

COLOR REDUCTION (NPA scale

	Test No 1		Test No 2	
	Activated Clay	Natural Clay	Activated Clay	Natural Clay
Original	4	4	4	4
After 5 min	3	4	2	2½
After 15 min	3	3½	2	2
After 30 min	2½	3	2	2
After 60 min	2½	3	2	2

INTERFACIAL TENSION CHANGE WITH VARYING CONTACT TIME

	Interfacial Tension—Dynes/cm. at 20 C.			
	Activated Clay	Natural Clay	Activated Clay	Natural Clay
Original	13.2	13.2	24.0	24.0
After 5 min	28.5	18.0	42.7	37.6
After 15 min	29.6	22.8	42.9	41.5
After 30 min	30.3	27.0	43.7	43.0
After 60 min	30.4	26.7	44.0	44.4

INTERFACIAL TENSION CHANGE WITH VARYING ADSORBENT DOSAGE

	Interfacial Tension—Dynes/cm. at 20 C.			
Dosage Lb Per Gal.	Activated Clay	Natural Clay	Activated Clay	Natural Clay
Original	13.2	13.2	24.0	24.0
0.10	19.0	17.4	35.2	33.6
0.25	23.1	21.4	40.3	37.9
0.50	26.2	26.0	41.3	40.8
1.00	31.1	28.5	43.9	44.0
2.00	34.3	37.2	44.7	44.6

Activated vs. Natural Adsorbents

In the conditioning of transformer oils, activated adsorbents have been employed to some extent—particularly in the alkali-treatment process as a finishing step following alkali neutralization. Because activated clays are not available in granular form, they are not suitable for percolation type units which employ material in the 30-90 mesh sieve range. However, the activated clays are quite suited to chemical type treating systems where the fine clay is added directly to the mixing tank and thoroughly contacted with the oil after which it is allowed to settle. Any remaining clay is subsequently removed by a centrifuge and or blotter press.

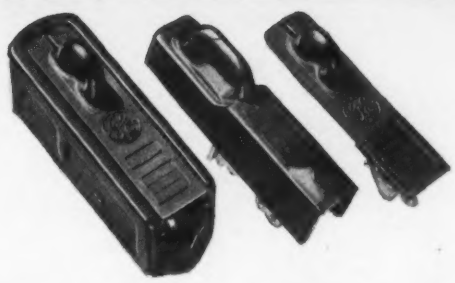
Since the question of the comparative efficiency of these two types of adsorbents is often debated, our laboratory undertook a series of comparative tests. Typical used oils were employed. The results seem to indicate that there is little difference in the adsorptive capacity where used oils are concerned providing the contact time in the case of natural clay is adequate. The data on these comparative tests are given in Table I.

PRIMARY FUSE CUTOUTS

for all service requirements

Compare each with its field for reliability, performance and flexibility of application!

INDICATING—DROP-OUT—RECLOSING



Interchangeable doors make these enclosed cutouts the most versatile in their field. *Three interchangeable doors*—indicating and drop-out, two-element reclosing, and disconnect—available for each current rating; *fit both the 5-kv and the 7.5-kv housings*. Just five major stock parts, for both 50- and 100-ampere ratings, fill all your requirements. Bulletin GEA-3448-B tells the complete story.

NON-INDICATING

These cutouts, lowest in price of all wet-process porcelain-enclosed cutouts, enable appreciable savings where indication is not necessary.

With exceptionally liberal design of contact areas and interlocking barriers, these cutouts are tops in the non-indicating field.

More than a million and a half in service have proved their high mechanical and electrical strength, and overall durability. Bulletin GEA-2390-C gives complete information.

OPEN-TYPE, DROP-OUT

This is the first "bird-proof" cutout in the open-type drop-out field. The mounting support is cemented into the one-piece solid insulator in the *opposite side* from all live parts—minimizing possibility of bird or animal blowing a fuse by touching a live part and the mounting at the same time. Note the closely coupled fuseholder which can be removed or replaced easily with standard switch stick.

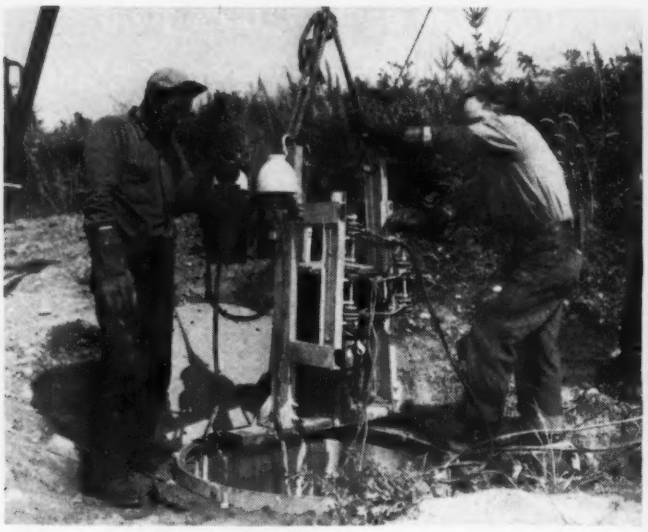
FLIP-OPEN

A low-cost cutout for primary fusing of rural lines where possible short-circuit current is limited. Like the open-type drop-out cutout the Flip-open cutout is virtually "bird-proof." Double-wedge silver-plated contacts grip the fuse link cable. Helical-wound springs retard vibration stresses on fuse link. Like all G-E cutouts, the mounting support is cemented into the porcelain insulator for exceptional strength and durability. Bulletin GEA-4224-A gives details.

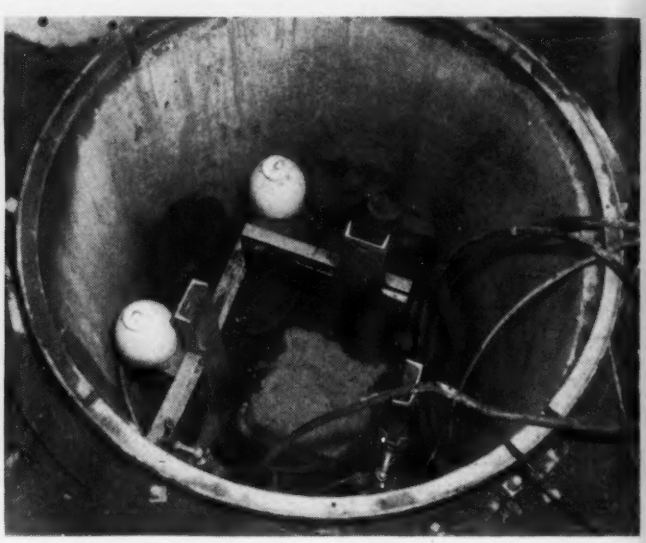
General Electric also has a complete line of oil fuse cutouts, secondary cutouts and fuses, and universal conventional and Hi-surge fuse links. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

GENERAL ELECTRIC

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



STEEL RACK hoisted from the vault to allow access to equipment. This arrangement removes necessity of entering vault to install, repair or remove transformers. White porcelain diving bell type cover protects open primary connectors against submersion



PRECAST cylindrical concrete vault used by Puget Sound Power & Light to reduce cost of underground residential service. Removable steel rack supports a standard distribution transformer, 5-25-kva, oil-immersed cutouts, primary and secondary terminal devices

Precast Vaults Cut Underground Costs

C. F. MYERS
Engineer
Puget Sound Power & Light Co, Seattle

PUGET SOUND POWER & LIGHT COMPANY has developed the precast cylindrical concrete transformer vault shown for installation of underground residential service. Installed cost of this vault is materially less than the installed cost of the conventional type of vault. It has meant an appreciable reduction of total cost of such installations.

The new vault is 54 in. high, with inside diameter of 42 in. and wall thickness of 4½ in. A structural steel rack supports the transformer (5-25 kva), oil-immersed cutouts, diving bell type primary connectors, terminal devices and secondary cable rack. The steel rack rests on concrete blocks, which in turn rest on a gravel or crushed rock bottom.

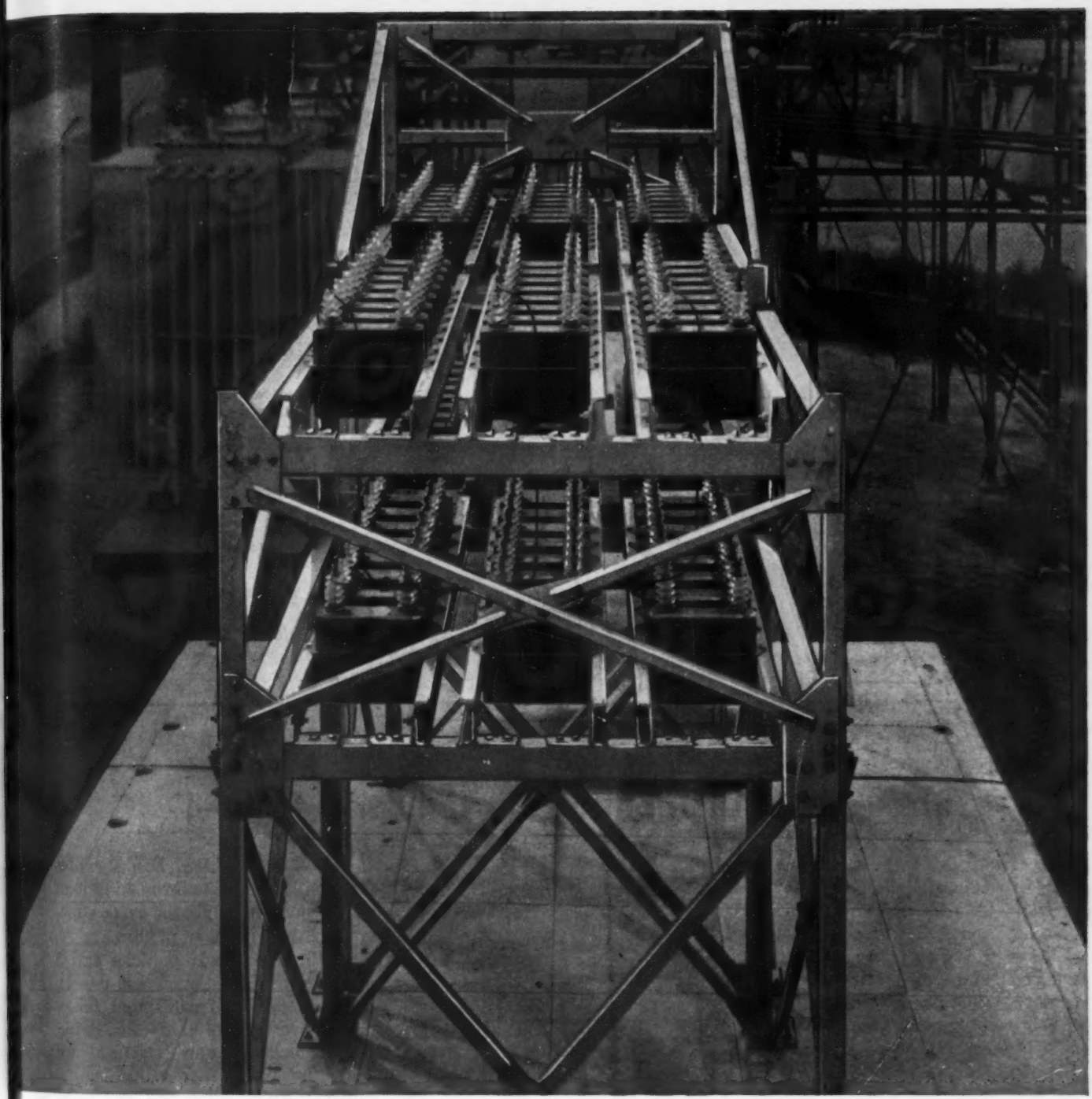
Washington state law requires that where men enter a vault to work on voltages above 300, the vault must be at least 6 x 6 x 6 ft. When the equipment in these vaults requires attention, the whole framework is lifted out as shown. By the use of insulated high-voltage connecting devices it is possible to install or remove the transformer and make connections on the surface. Thus, men are never required to enter the vault to work on the equipment.

Standard overhead distribution transformers and oil-immersed cutouts are used. The only special provision for underground conditions is the diving bell type primary terminal device. It consists of an inverted porcelain cup which forms an air lock protecting the disconnecting studs. This device provides for connecting six insulated primary taps to the single insulated primary conductor. The air pocket protects all these connections.

The design is not intended to be submersible for long periods. It is used only where it is a safe distance above the water table. Ordinary leakage around the cast-iron cover of the vault causes no harm. Drainage of the vault, where necessary, is provided by a small pipe running downgrade a short distance.

Synthetic rubber insulated and jacketed primary and secondary cable runs to the vault are laid in underground nonmetallic conduit. Seven of the vaults, using a 2,400-v, single conductor No. 4 primary, are being installed in one new tract in Bellingham, Wash. Each vault will serve eight lots with two No. 1, 600-v cables and one No. 4 weatherproof neutral buried underground. Services to the customers will be three-wire No. 4 from the secondary.

These vaults effect a substantial reduction in underground construction costs for exclusive residential areas where the customer is willing to pay an appropriate premium for underground construction.



Bank of capacitor units connected to 4-kv substation bus of Southern California Edison Company.

being installed where local conditions justify the use of automatic control.

"All low power factor loads are being studied for the application of capacitors, to permit increased loading of existing transformer banks, and to keep distribution line and equipment losses at a minimum.

"Installations made so far have proved the soundness of our decision. We have increased system capacity and improved system efficiency."

The purpose of these advertisements is to encourage electrical utilities to exchange information on the use of power-factor-improvement capacitors. We believe that such an exchange will best bring out that capacitors can be used much more widely than at present—that they provide the fastest way of increasing peak-load capacity—that they can bring many utilities extraordinary returns by increasing capacity of existing distribution lines, transmission lines, transformers and circuit breakers—and that they offer one of the best possibilities of scaling down system costs per kilowatt. If your experience with capacitors would be of interest and value to other companies, we would like to hear from you. Contact your G-E Representative or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

407-8

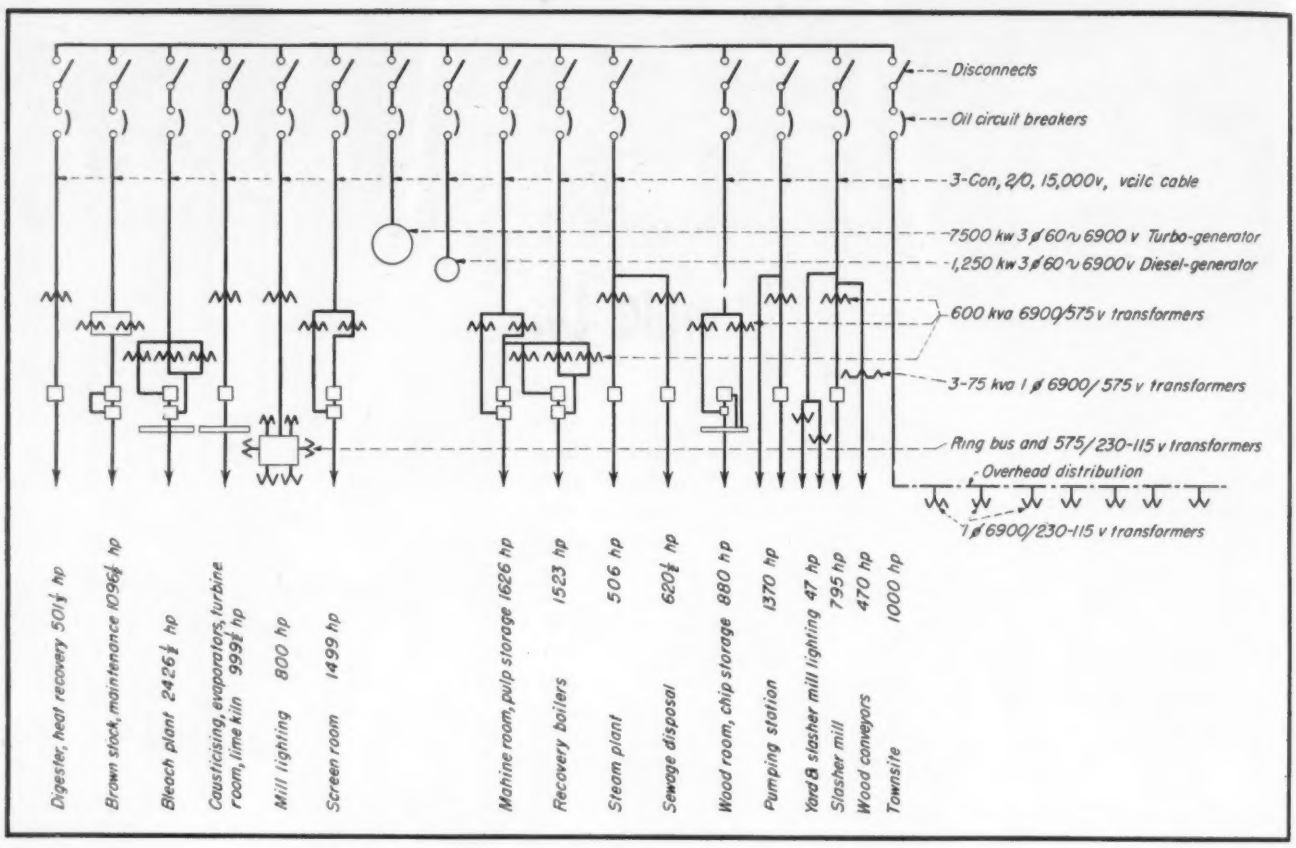

Disconnects
Oil circuit breakers
3-Con, 2/0, 15,000v, vcilc cable
7500 kw 3 ø 60 ∿ 6900 v Turbo-generator
1,250 kw 3 ø 60 ∿ 6900 v Diesel-generator
600 kva 6900/575 v transformers
3-75 kva 1 ø 6900/575 v transformers
Ring bus and 575/230-115 v transformers
Overhead distribution
1 ø 6900/230-115 v transformers
Digester, heat recovery 501½ hp
Brown stock, maintenance 1096½ hp
Bleach plant 2426½ hp
Causticising, evaporators, turbine room, lime kiln 999½ hp
Mill lighting 800 hp
Screen room 1499 hp
Machine room, pulp storage 1626 hp
Recovery boilers 1523 hp
Steam plant 506 hp
Sewage disposal 620½ hp
Wood room, chip storage 880 hp
Pumping station 1370 hp
Yard & slasher mill lighting 47 hp
Slasher mill 795 hp
Wood conveyors 470 hp
Townsite 1000 hp

FIG 1 - DISTRIBUTION SYSTEM has 13 feeders to serve mill load and townsite requirements

Streamlined Distribution For Industrial Plant—I*

H. E. STAFFORD
Consulting Electrical Engineer
Port Arthur, Ontario

IN LAYING OUT the distribution system for a sulphate pulp mill in northwestern Ontario, the "load-center" idea has been used to good advantage. The system is a radial type. It serves a much-mixed connected load of about 14,300 hp of induction and synchronous motors, also 1700 kw of mill lighting and townsite load. All power is supplied by a 7500-kw, 0.8-pf, 6900-v 3-phase 60-cycle turbine-generator operating at 650-psi steam pressure, and an auxiliary 1250-kw diesel unit for peak and emergency use.

Fig 1 is a one-line diagram of the distribution system, indicating load centers, high-voltage cables and connected load on each of the 13 feeders. Fifteen main load centers have one to three transformers and feed a number of sub-load centers. A total of 21 load-center transformers are 600-kva, 6900/575-v, 3-phase, Inerteen filled units.

Load-center cubicles, Fig 2, differ from usual factory-built types in that breakers and starters are mounted outside. Cubicles are a standard 6x6 ft size or a multiple of these dimensions and are 7 ft high. Feeder cables are readily accessible for making load tests. Space is ample for extra starters as expansion may require.

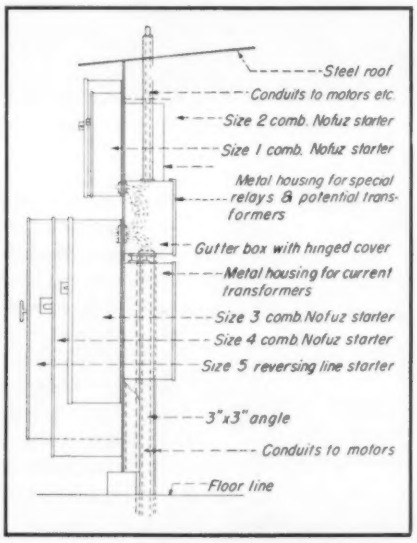

Steel roof
Conduits to motors etc.
Size 2 comb. Nofuz starter
Size 1 comb. Nofuz starter
Metal housing for special relays & potential transformers
Gutter box with hinged cover
Metal housing for current transformers
Size 3 comb. Nofuz starter
Size 4 comb. Nofuz starter
Size 5 reversing line starter
3"x3" angle
Conduits to motors
Floor line

FIG 2 - CUBICLES SUPPLYING large motors are unusual in that the breakers and starters are mounted outside. Outline shows one side only

In all, there are 15 cubicles and 5 panels, with several small sub-panels. Breakers for sub-feeders and 550-v motors over 100 hp are Nofuz, deion type. Smaller motor starters are Nofuz magnetic across-line units. Mill-lighting transformers and individual lighting circuits are also protected with Nofuz breakers.

Cable and load arrangements will be outlined in another article in an ensuing issue.

* This is the first of two articles.

Measuring Temperature Of Energized HV Equipment

RAYMOND BAILEY
Voltage Control Engineer
Detroit Edison Co

ONE METHOD of measuring surface temperature above ambient of energized high voltage equipment, particularly disconnects, uses a

OIL CIRCUIT BREAKER

SEALED BUSHINGS

Completely-sealed bushings cut maintenance costs. Bushings are smaller, more compact, of simplified construction. Bushings can be readily adjusted to make alignment of breaker contacts easier.

IMPROVED DESIGN

New, simplified linkage of lightweight, antifriction construction means dependable high-speed performance. Other new features are a reduction in tank dimensions and over-all unit weight.

NEW INTERRUPTER

Cross-blast interrupters can be readily removed, disassembled, and inspected for field checking. They can then be easily reinstalled without disturbing in any way the adjustment of the breaker.

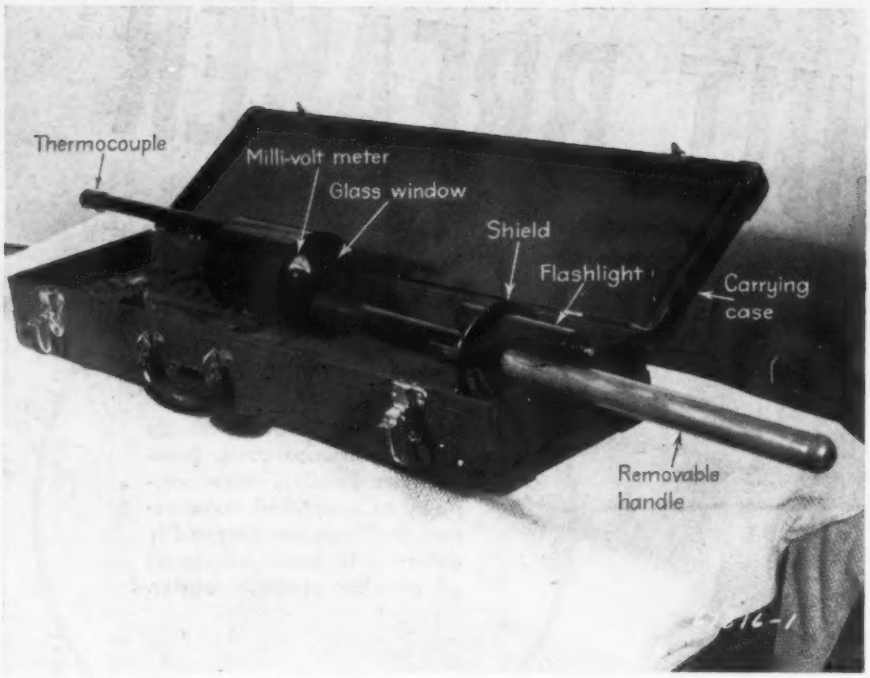
AIR MECHANISM

Type MA-14 self-contained air mechanism easily handles interrupting and reclosing duties down to low temperatures—with smaller batteries and control leads. Controls are readily accessible.

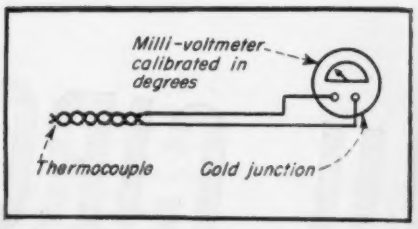
Your nearest G-E sales representative has further information on the new Type 439, 69-Kv oil circuit breaker. Write for our new Bulletin GEA-4985. Apparatus Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

859-10



DETACHABLE HANDLE lets temperature measuring instrument fit into small carrying case



COLD JUNCTION of the thermocouple is at the millivoltmeter

thermocouple and millivoltmeter combination.

For compactness and convenience, the thermocouple and millivolt meter are built into an insulated holder. The thermocouple is in the tip and away from the handle. The meter in an insulated box with a glass window, is about one third of the length away from the thermocouple. The cold junction is in the meter housing. A small pencil type flashlight is built in front of the meter near the handle, to make the meter easier to read in dark places.

The instrument is rated for use on circuits up to 23 kv. To measure the temperature rise of a disconnect switch, for example, the thermocouple end of the device is merely held in contact with the disconnect switch for a few seconds until the needle comes to rest. This temperature indicator is light and easy to use. The handle can be removed and the device carried in a case.

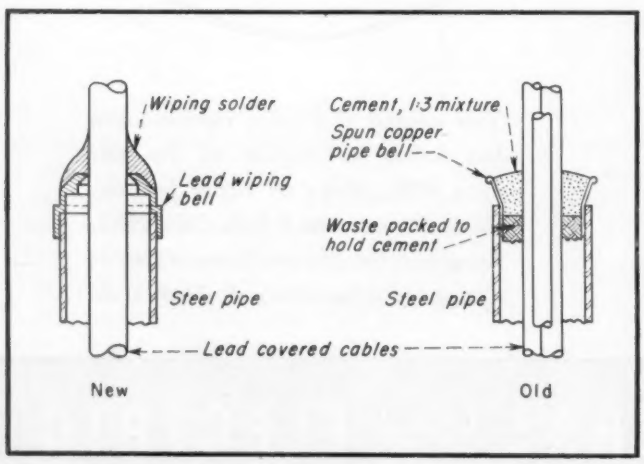
Changing Pipe Bells Eliminates Cable Sheath Corrosion

L. F. GREVE
Corrosion Engineer
Commonwealth Edison Co.
Chicago, Ill.

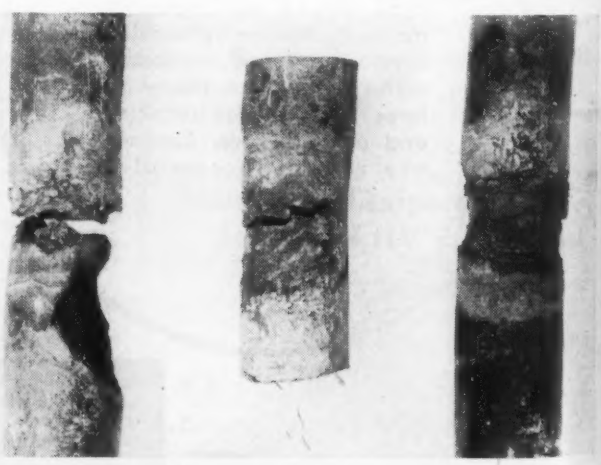
CHANGING PIPE BELLS has eliminated cable sheath corrosion at the top of the iron pipe on cable poles. The new design, using the lead bell instead of the copper, and using a wiping solder rather than a cement to center and support the conductor and to keep out moisture, has eliminated the causes of corrosion.

Both methods are illustrated. The newer design (below, left) utilizing the lead wiping bell, was substituted for the spun copper type bell after several failures. It was found that the older design had these two undesirable features: (1) The copper and lead often set up a galvanic cell and (2) An electrolyte was often formed by the water seeping through the cement.

Experience with the new design has been so successful that it has been planned to make all future installations and necessary replacements in this manner.

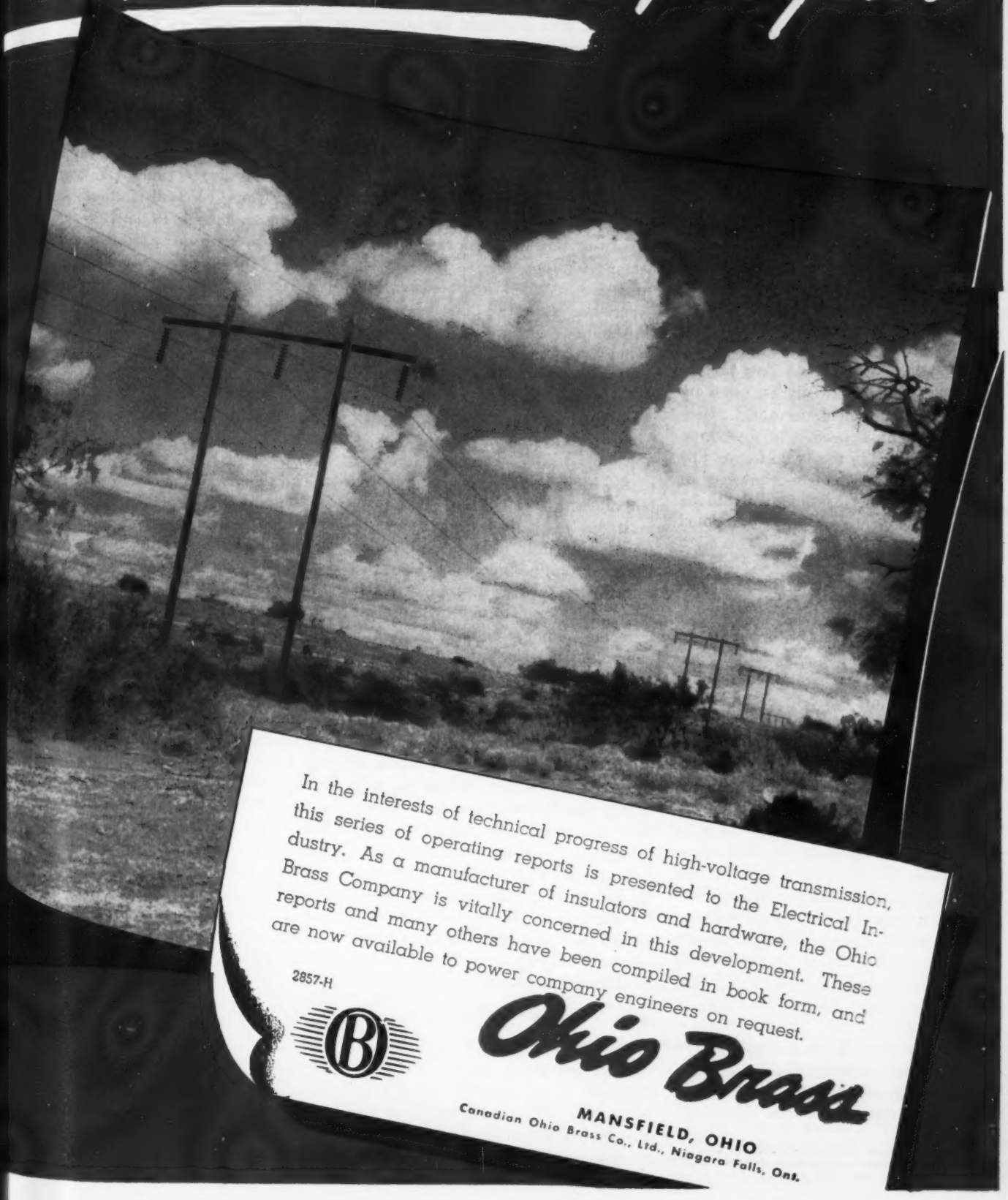


NEW AND OLD methods of installing pipe bells



TYPICAL cable sheath corrosion on poles using old design

149 Storm Hours per year



In the interests of technical progress of high-voltage transmission, this series of operating reports is presented to the Electrical Industry. As a manufacturer of insulators and hardware, the Ohio Brass Company is vitally concerned in this development. These reports and many others have been compiled in book form, and are now available to power company engineers on request.

2857-H

Ohio Brass

MANSFIELD, OHIO

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

A Graphic Method for Determination

Accompanying chart is derived from compilation of published data and it should be interpreted only as a guide to practical operation and observation

L. M. APPLEGATE
Bonneville Power Administration
Portland, Ore.

TEMPERATURE AND TIME are generally recognized as criteria for determining transformer loading. Several graphical relationships of load and temperature have been published.[1] These authoritative treatments are somewhat more exhaustive and elaborate than necessary for the rough estimates usually required by operating and field personnel. Usually all that is needed is something that will enable the operator or dispatcher to approximate the degree of hazard or deterioration likely to be the consequence of an anticipated overload.

Average Conditions

The accompanying chart has been prepared on the basis of the published authorities with some simplifying assumptions. These simplifications restrict the chart to average conditions in which it is assumed that duration of the overload is sufficient for the transformer to come to within a few degrees of the steady-state temperature pertaining to a specified condition. Another simplifying assumption is that the temperature differences between the hottest spot and the average copper, and between the average copper and the top oil are proportional to the overload percentage of rated temperature at rated load. It is assumed also that the rated load ratio of copper loss to iron loss is always 2.0.

Any loss of accuracy entailed in these assumptions probably is insignificant in view of the usual roughness of overload estimates. Even with accurately known loads, calculated results must be accepted with the same reservations as were implied in AIEE Paper 45-130, in effect as follows:

"The percentage loss of life values are conservative. Transformer life expectancy with continuous hottest spot operation at 95 C. is not known but experience indicates that the life is satisfactory. Operation at hottest spot 115 C for 24 hr was assumed to give not over 1% loss of insulation life. It is pointed out that more than approximate accuracy in loss of life values is not implied."

An illustrative example of the use of the accompanying chart has been laid out with a dotted line. Judgment must be used in interpreting any transformer heating curves especially in relation to the time constant of the transformer. When the time involved is short the transformer will not attain the implied temperature. For example, if a 2½-hr run is made on a transformer that requires 2 hr of transient time to reach constant temperature, only ½ hr will be at full temperature. For a rough approximation to the loss of life involved in the transient period, it may be estimated that the total rise in temperature is accumulated logarithmically through the assumed transient time. Then an estimate of loss of life can be had by using the first half of the transient time at 0.6 of the final temperature rise, and the second half of the transient time at 0.9 of the final temperature rise.

Loss of Life

Applying this to the example laid out on the chart, assume that two transient hours preceded the ½ hr indicated. The contribution of the first hour is determined by taking 0.6 of the percent of rated temperature rise at the left of the hottest spot curves, or by taking 0.6 of the hottest spot degrees above ambient. The first is 0.6 times 284% or 170%. This corresponds to 0.6 times 125 deg or 75 deg. Going vertically to the 50-deg ambient curve, right to the 1-hr curve, and down to the loss of life curve, 0.1% is indicated as the hazard of the first hour. The second hour hazard using 0.9 times 125 deg to give 112 deg, leads vertically to the right, and down finally to about 3% for the hazard of the second hour. The total estimated loss of life for the 2½-hr period would be 7.2% or less.

Chart Locates Range

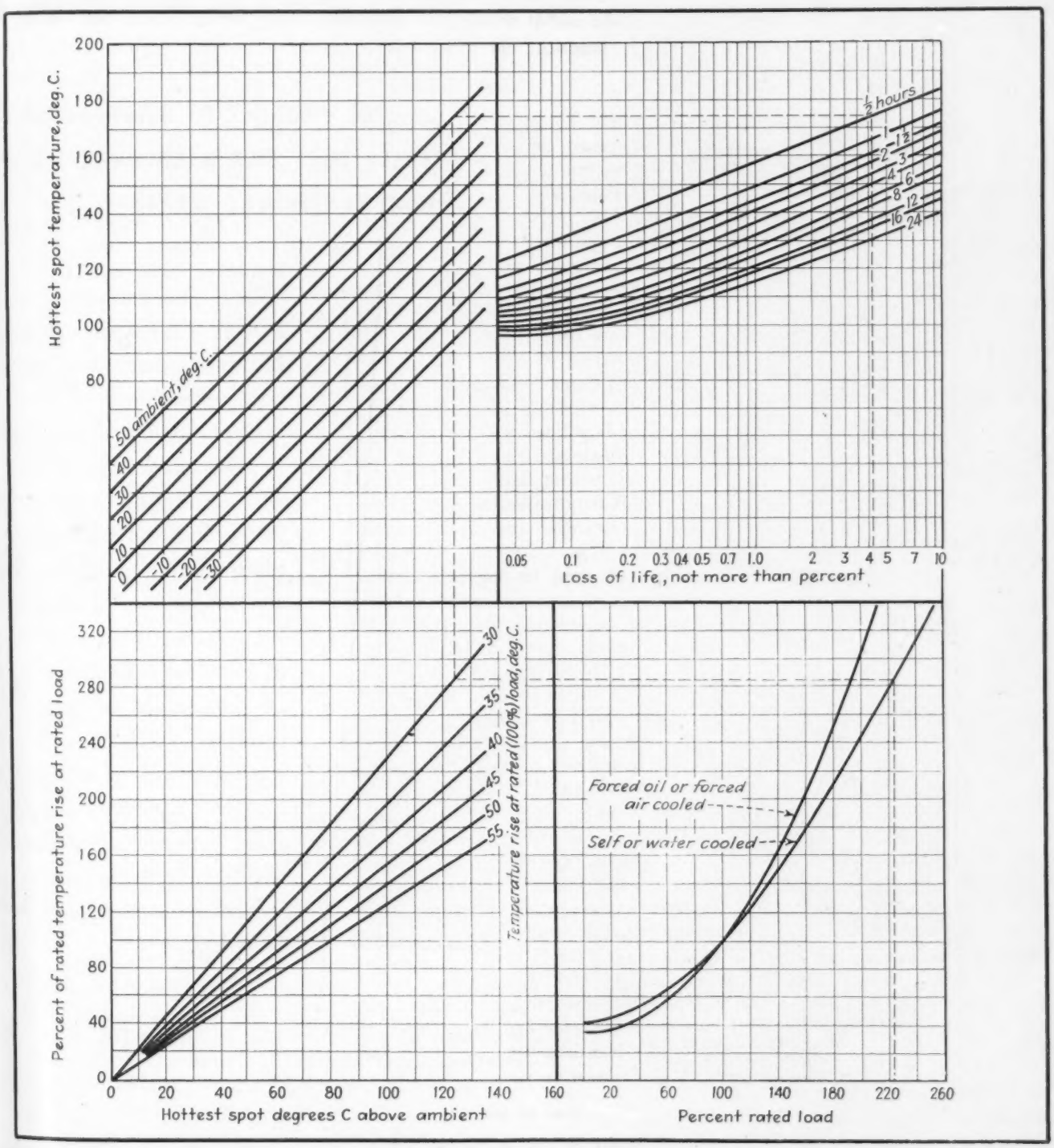
This chart, in placing the hottest-spot-loss-of-life curves in fixed relationship to the temperature curves, permits a quick working back to the overload scale to locate the permissible operating range of overload. Starting with an acceptable loss of life, going to the left to the probable range of ambient temperature and down to the rated temperature rise curve for the transformer under consideration, it will be found that there is usually a restricted range between the load corresponding to the generally acceptable hottest spot temperature of 95 C and the permissible overload. This derived overload can then be posted as the operating limitation.

There are some reasons to believe that the published data are unnecessarily conservative in the region of hottest spot temperature from 95 C to about 120 C, but lacking complete data the risk of long periods of operation at high temperatures should be avoided if possible.

It will be desirable and instructive to record data on periods of overload exceeding 95 C hottest spot on individual transformers, when feasible, to provide a background of experience and judgment to be applied in the use of the chart.

[1] Leading articles are Hansen, Allis Chalmers Review, March 1944; Narbutovskih, Electrical World, January 3, 1948; and AIEE Technical Paper 45-130, 1945.

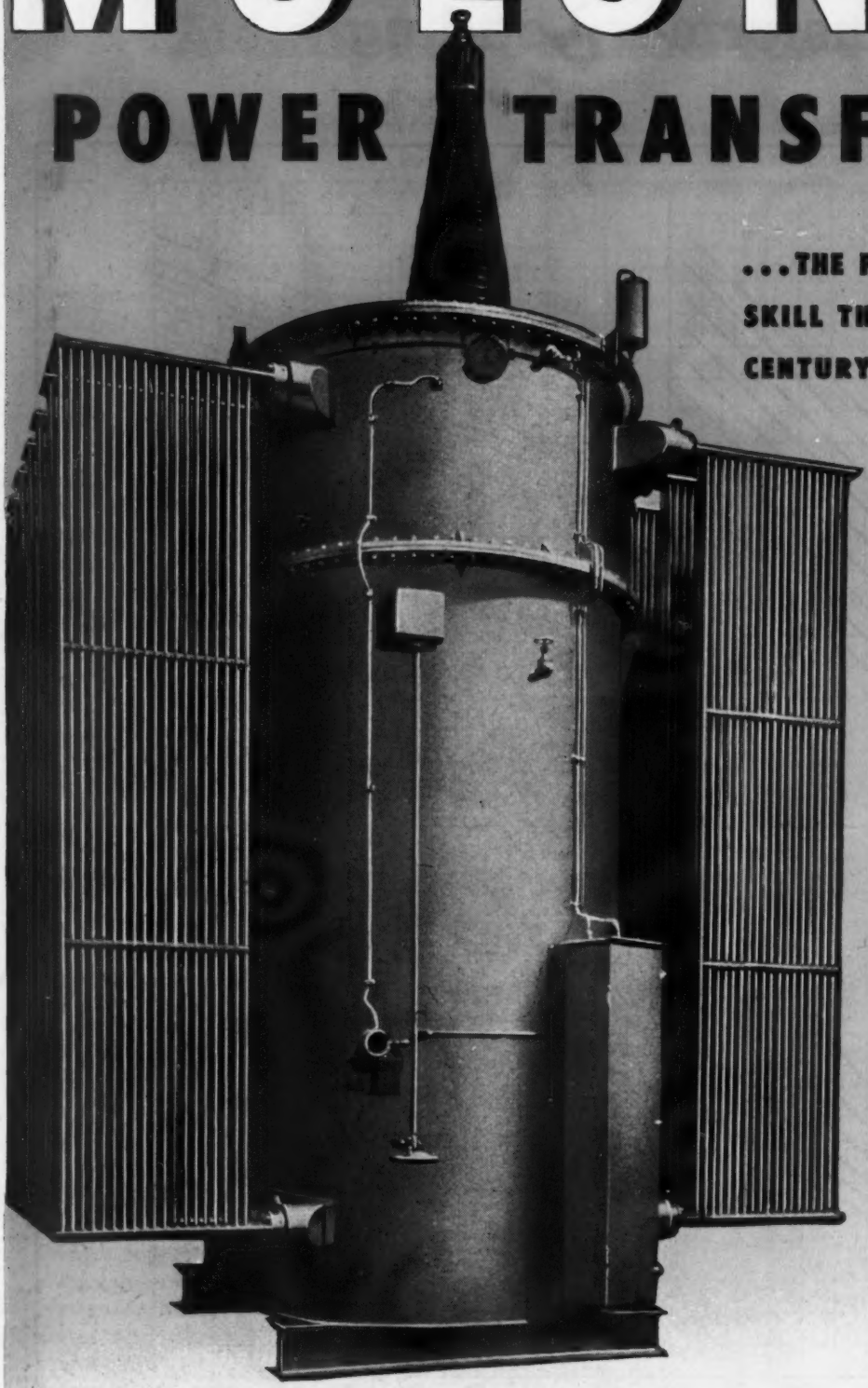
# of Power Transformer Loading



TRANSFORMER LOADING CHART. Example of use is shown by dotted line. Beginning at 225% of rated load, read up to the appropriate curve, in this example, "self-cooled". Read to the left to the rated temperature rise at rated (100%) load, for example, 30 C. From this curve, incidentally, a projection to the left gives the overload temperature rise expressed as percentage of the rated rise, in this example, 284% of 30 C. Also, from the same point, by dropping vertically, the hottest spot rise above ambient is read at 124 C. Proceeding with the dotted line vertically up, intersect the ambient temperature, in this instance 50 C. Projecting to the left at this intersection gives the hottest spot temperature (174 C). Following the dotted line to the right to intersect the desired time curve, in this illustration one-half hour, drop to the loss of life scale, reading now approximately 4.3%

MOLONEY

POWER TRANSFORMERS



...THE PRODUCT OF MANUFACTURING SKILL THAT HAS BEEN OVER HALF A CENTURY IN THE MAKING...

When you purchase your Power Transformers from Moloney, you are buying precision equipment which has been planned, built, and *tested* to give uninterrupted service with minimum maintenance. Designing and fabricating a giant transformer requires a combination of skill and know-how... born of years of experience in the making of thousands of previous transformers. In a sense, we started building your transformers a little over fifty years ago... yet your transformers will have improvements *over any other transformers now in existence!*

MOLONEY ELECTRIC COMPANY

POWER AND DISTRIBUTION TRANSFORMERS SINCE 1896

SAINT LOUIS 20, MISSOURI ☆ TORONTO, ONTARIO, CANADA

FIRST...
THE ENGINEER'S PROBLEM...

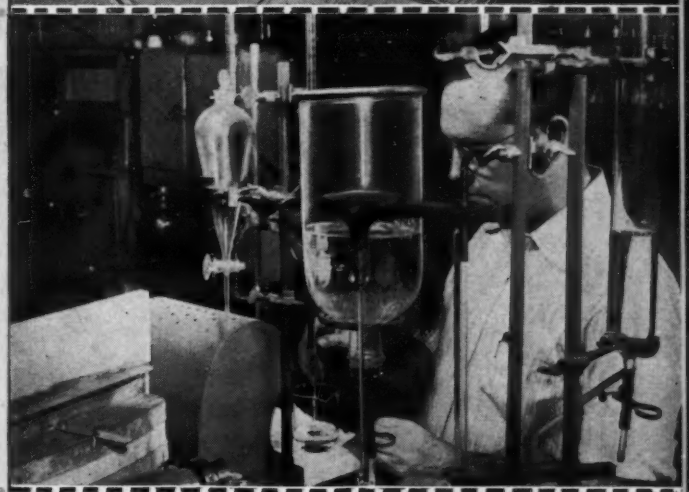
Your specifications of winding capacities and voltages must be translated into terms of cores, windings, insulation, bushings, terminal boards, tap changers... and many other items of design. Moloney engineers know the right answers. At their fingertips are the Moloney files... *fifty years in the making*... a veritable gold mine of information.

NEXT, THE DRAFTSMAN...

Taking the engineer's electrical design, the draftsman must develop the mechanical design, which includes the core clamping structure, lead supports, terminal boards and other items necessary for a complete core-and-coil assembly. In locating the various parts, he must provide adequate electrical clearance and creepage to prevent internal flashovers. Next, the tank must be designed and the size and number of cooling tubes or radiators calculated. These are but a few of the details where Moloney's experience really counts.

THE LABORATORY... TROUBLE SHOOTING BEFORE TROUBLE CAN BEGIN...

It is here that the raw materials... the steel, the copper, the oil, the insulating materials, etc., are tested to determine whether they meet Moloney specifications. Materials are checked in advance of use... in effect, trouble shooting before trouble can begin. Here in the Moloney Laboratories experienced engineers and technicians, using modern equipment and new techniques, pre-test raw materials in order to insure the trouble-free, uninterrupted operation you expect from your Moloney Transformers.



ENGINEERING DEPARTMENT...

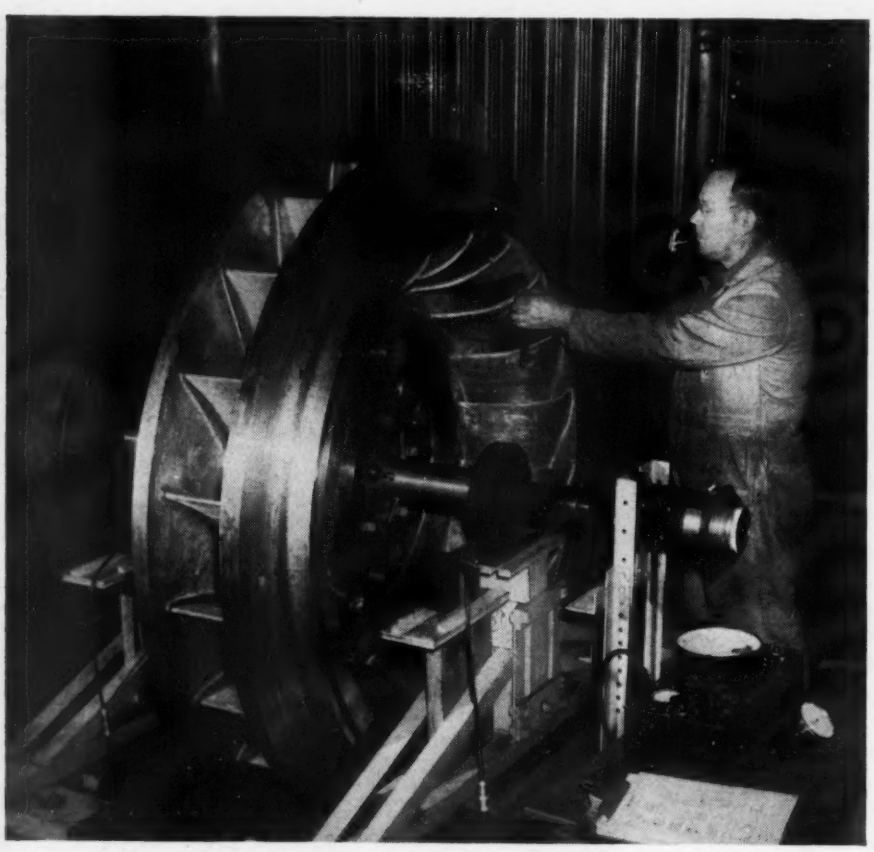
Moloney's highly trained engineers are skilled in every phase of transformer theory and practical application. The "blueprinting" of a Moloney Transformer is no one-man job... it is a job that utilizes the combined know-how of many specialists, each an expert in his field of transformer design. Moloney's large staff of experienced engineers can design transformers to meet *your* particular requirements... and which will provide many years of reliable service.

Converted Panel Truck Houses Hot Line Tools

NEW "HOT LINE" TRUCK built from a war surplus panel truck in the shops of the Puget Sound Power and Light Co, Seattle, has its interior fitted with special slots and racks for each piece of live-line equipment. Used independently of line trucks and manned by a crew of five, under the supervision of L. G. Hayden, above, the truck is routed to all divisions as need requires, to work on energized lines in the voltage range up to 110,000 v

Stainless Steel Runners for Lower Maintenance

SUCCESSFUL PAST EXPERIENCE with stainless steel inlays on surfaces of hydraulic turbine runners subject to cavitation has now led to use of runners cast of stainless steel. Such inlays on wicket gates in plants of the Los Angeles Department of Water and Power have shown no appreciable wear after seven years of use. The city recently purchased five replacement runners cast of stainless steel. These will combat rising maintenance costs from cavitation, corrosion and erosion on bronze runners which cannot be inlaid with stainless steel. The relatively small increase in cost over conventional runners, it is anticipated, will result in a material reduction in maintenance.



SOLID STAINLESS STEEL RUNNER that will replace bronze runner in San Francisquito powerhouse of Los Angeles Department of Water and Power to combat problems of cavitation, corrosion and erosion

Largest of these runners, shown being checked during dynamic balancing, was installed in a 17,500-kva, 514-rpm unit at San Francisquito powerhouse No. 2. Dynamic balancing of this runner resulted in the machine operating very smoothly, minimizing wear of the turbine bearing and packing.

Systematic Inspection Safeguards Operation

R. H. MERTZ,
Electrical Apparatus Engineer
A. C. BÅUMANN,
Electrical System Chief Inspector
Detroit Edison Co
Detroit, Mich.

ELECTRICAL EQUIPMENT intended for use in stations and substations on the Detroit Edison system is given a mechanical inspection and electrical tests when received new

The Last Word in Connectors---

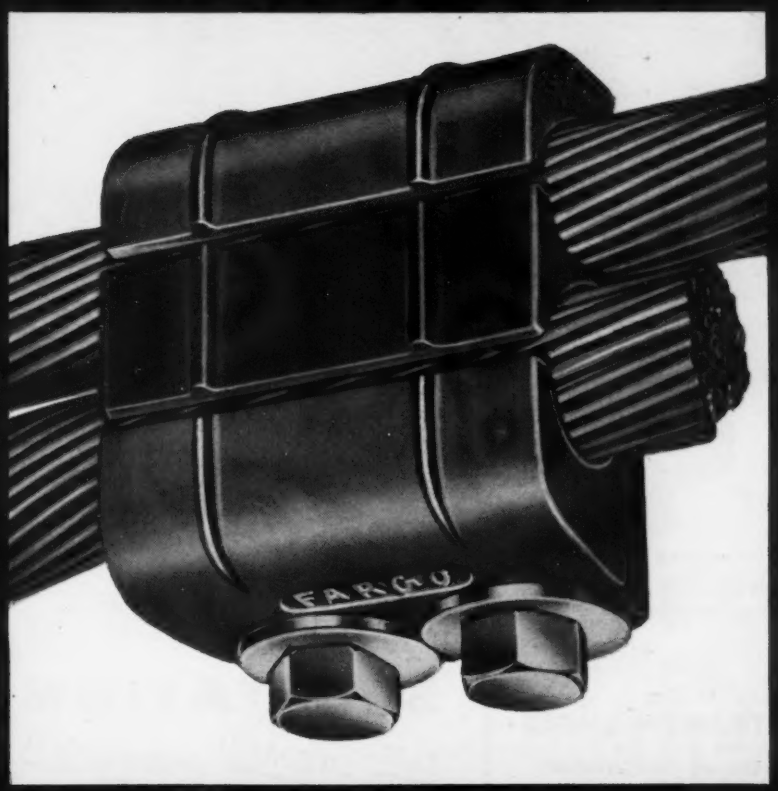
FARGO'S TWO BOLT HEAVY DUTY SERIES

7000 Series

Developed for heavy duty distribution and transmission applications.

It has---

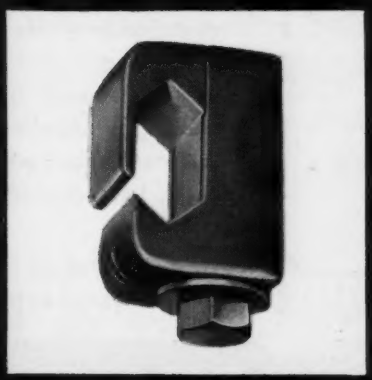
1. More mass for greater heat dissipation under short circuit conditions.
2. Bronze body for mechanical strength.
3. Two Duronze bolts for added compression force.
4. Wide jaws for larger contact area.
5. Copper spacer for low resistance contact between conductors.
6. Fitted grooves, conductor shaped, for good contact between strands,
7. Greater enclosure of conductor to retard corrosion.
8. All the advantages of FARGO one-piece vise-type construction.



"Built like a vise — grips like a vise"

5000 Series

The popular connectors for routine distribution--- primaries, secondaries and services. It has "V" grooves for flexibility of wire sizes, high compression ratio and good electrical and mechanical stability.
"Easy-to-use" one-piece, vise-type construction. Only two bolt head sizes for 8 sizes of FARGO connectors. (No. 8 to 4/0)



FARGO

Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

Manufactured by
FARGO MFG. COMPANY, INC.
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LM

1000 KVA Transformer with primary and secondary switchgear.

AIR-COOLED
TRANSFORMERS

- SPECIAL TRANSFORMERS, 1 to 1000 KVA To Meet Individual Requirements
- RECTIFIER TRANSFORMERS
- WELDING TRANSFORMERS
- ELECTRIC FURNACE
- PHASE CHANGING
- GENERAL PURPOSE
- MOTOR STARTING
- TAPPED AUTO

MARCUS UNIT
AIR-COOLED
SUBSTATION

SAFE! COMPACT! ECONOMICAL!

Marcus Unit Substations are available in sizes from 100 to 1000 KVA in primary voltages up to 15000 V. They are made with various types of entrances and controls for primary, high voltage circuit. The low voltage side can be designed for any type and number of breakers according to customer requirements. Class B and C, heatproof insulation featured throughout.

GOOD DELIVERIES • FIRM PRICES
NO ESCALATOR CLAUSES

PIONEERS IN THE FIELD OF AIR-COOLED TRANSFORMERS

MTC

MARCUS TRANSFORMERS CONFORM TO THE STANDARD OF N E M A AND A I E E

MARCUS
TRANSFORMER CO.
INC.
30 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

from the factory, after rehabilitation when received from the field, and at regular intervals. The basic purpose in this procedure is to detect and correct defects in the equipment before major damage or service failure results.

Apparatus such as power transformers, voltage regulators, lightning arrestors, insulators, bushings, and oil circuit breakers, passes through this routine procedure.

Some typical examples of the defects found by inspection and test that might later have led to trouble are listed.

15 Shop Experiences

In the shop the following conditions in equipment, such as transformers, were found:

1. A new 10,000-kva transformer had a defective brazed joint. It was found that about four out of 18 strands were holding. This defect was located by measuring the winding resistance.

2. A new 333-kva transformer had intermittent shorted turns at crossover in winding. Found by radio interference test.

3. A 500-kva transformer, rewound at factory branch, had high core loss. All the iron had not been replaced at the factory. Found by core loss measurement.

4. An 8,500-kva transformer, rewound at the manufacturer's shop, was off ratio. Coil was reversed. Found by ratio test.

5. An 8,500-kva transformer broke down on high potential test. Failure developed from creepage on the baffle between the high and low-voltage windings.

6. A 25-kv dry-type transformer bushing caused radio interference. The lead was not properly spaced in the porcelain shell. Found by test for radio interference.

7. A condenser-type bushing had defective condenser layers which were identified by capacitance measurement.

8. A breaker-supporting bushing had a crack under the collar. Found on high frequency test.

9. While applying vacuum to a new 2,500-kva transformer, the main cover weld broke. Subsequently an internal horizontal tank brace was found broken.

10. A metal washer was found in

with

Guthlite*

"Jacknife" Maintenance

EVEN A CHILD CAN

CHANGE LAMPS AND STARTERS!

WITH A TWIST OF THE WRIST--
LAMPS AND STARTERS ARE AT YOUR FINGER TIPS

It's so simple — and it's all accomplished right from the floor! No ladders — no fuss — no bother! A twist of the wrist with the light-weight magic maintenance wand and the GUTHLITE swings open on the patented Jacknife Hinge. Then lamps or starters are quickly replaced, and the reflector swung back up. It takes just a few seconds — and anybody can do it, even a child!

YOU'LL WANT ALL THE FACTS ABOUT
GUTHLITE
WRITE TODAY FOR BULLETIN 7845B

*Trade Mark, U. S. & Can. Pats. Applied For

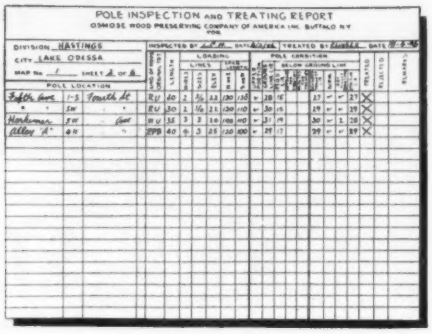
THE EDWIN F. GUTH CO. • ST. LOUIS 3, MO.

LEADERS IN LIGHTING SINCE 1902

ADD OSMOPLASTIC TO YOUR '49 BUDGET ...and you add years of LIFE to your OLD poles

OSMOPLASTIC GROUND LINE *treatment*

1 LOWERS POLE MAINTENANCE COST

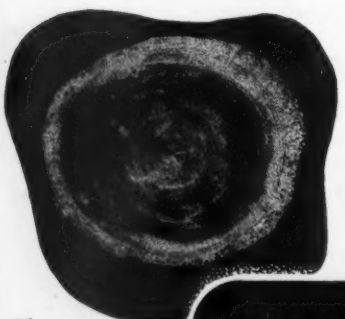

POLE INSPECTION AND TREATING REPORT
OSMOSE WOOD PRESERVING COMPANY OF AMERICA INC. BUFFALO N.Y.

2 GIVES YOU THIS ACCURATE POLE RECORD

Groundline decay* of standing poles eats a big hole in every Operating Budget! Plan NOW to drastically reduce FUTURE pole replacement costs with Osmoplastic Groundline Treatment which not only protects the surface but penetrates deep into the wood destroying all fungi and preventing further decay. While treatment is being applied, the above card is filled in which gives you a complete Pole Record and Inventory to facilitate future planning.

Many prominent utility companies have cut their operating costs and increased their efficiency with this simple, inexpensive but highly effective Osmoplastic treatment. Let us submit estimates and explain how our experienced field crews can handle this work for you at surprisingly low cost. Or, if your prefer, we will supply the materials for your own application. Write today for complete details!

*From six inches above to twelve inches below ground.



Above:

White areas of this pole cross section show the deep penetrating action of the toxic chemicals in Osmoplastic.

MAKE INSPECTION TIME, PROTECTION TIME WITH

OSMOPLASTIC

Patented and Patents Pending

OSMOSE WOOD PRESERVING COMPANY OF AMERICA, INC.

GENERAL OFFICES: BUFFALO 12, N. Y.

BRANCH AND SALES OFFICES: BIRMINGHAM 3, ALA.; DENVER 2, COLO.

the winding of a new 6,000-kva transformer.

11. The shipping braces were found loose and the bolts were in the bottom of the tank of a new transformer.

12. On many old induction regulators loose rotor bands, (some having fallen to the bottom of the tank), were found when rotor was removed from stator.

13. Silver sulphide has been found on many silver plated ratio adjusters of used transformers. In some cases it had become thick enough to flake off and pile up across terminals. This later might have caused a short circuit.

14. A shipping tag was found wired to the coil turns of a new transformer.

15. On some 18-year old voltage regulators rotor coil insulation had been found so puffed out that it rubbed against the stator iron; on others, the varnish appeared to have migrated from the tape on the coils.

Typical Field Changes

In the field while changing taps these two conditions were revealed:

1. From 7½ to 10% on a bank consisting of three 20,000-kva, single-phase, 120,000/24,000-v transformers, winding resistance measurements varied from 15 to 65% above the original figures. For several years this bank had been carrying two-thirds load. Investigation showed that one of the primary leads on each unit had been burned away at a lugged joint due to heating and there remained only a charred mass which was held in position by the insulating tape.

2. From 5 to 2½% on an 8,500-kva, 3-phase transformer, the winding resistance measurements on one phase were found to be erratic. When an attempt was made to move the ratio adjuster of another phase into the new position the mechanism stuck. When the ratio adjusters were inspected, they were found to be making poor contact.

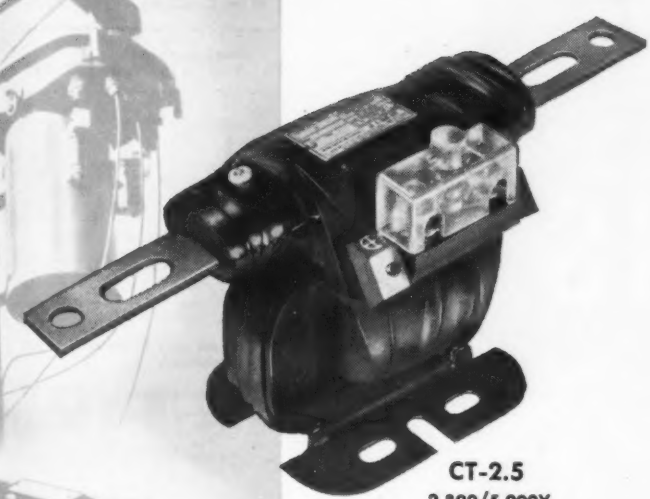
How to Select Pole Class For Carrying Stated Wires

CURRENT PRACTICE of Central Maine Power Co takes account of ultimate probable loads on poles in deciding

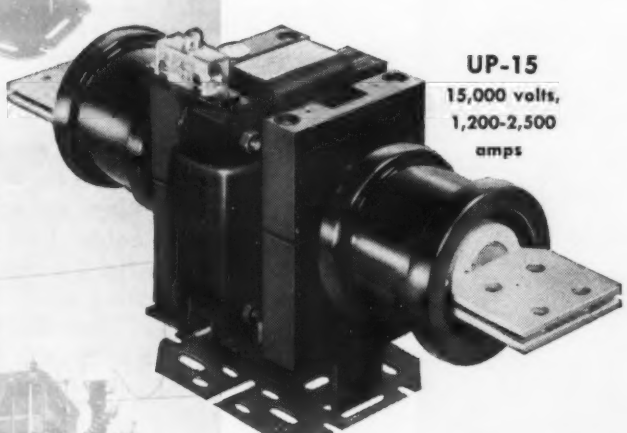
NEW

TWO NEW CURRENT TRANSFORMERS

for dependable accuracy at high and low ratings



CT-2.5
2,890/5,000Y volts,
10-800 amps



UP-15
15,000 volts,
1,200-2,500 amps

TYPE CT-2.5

This new addition to the well-known Westinghouse CT line of instrument transformers is designed for low voltages. It provides high accuracy and 45-kv impulse strength for metering and relaying applications.

TYPE UP-15

The new UP-15 provides exacting accuracy for metering and relaying applications at higher ratings. Wet process porcelain insulation surrounding the heavy, bar-type primary guarantees a more consistent margin of strength.

Westinghouse indoor current transformers, the most complete line in the industry, are backed by the type of research and development that assure top-quality performance. For complete information, write your nearby Westinghouse office or Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-70520

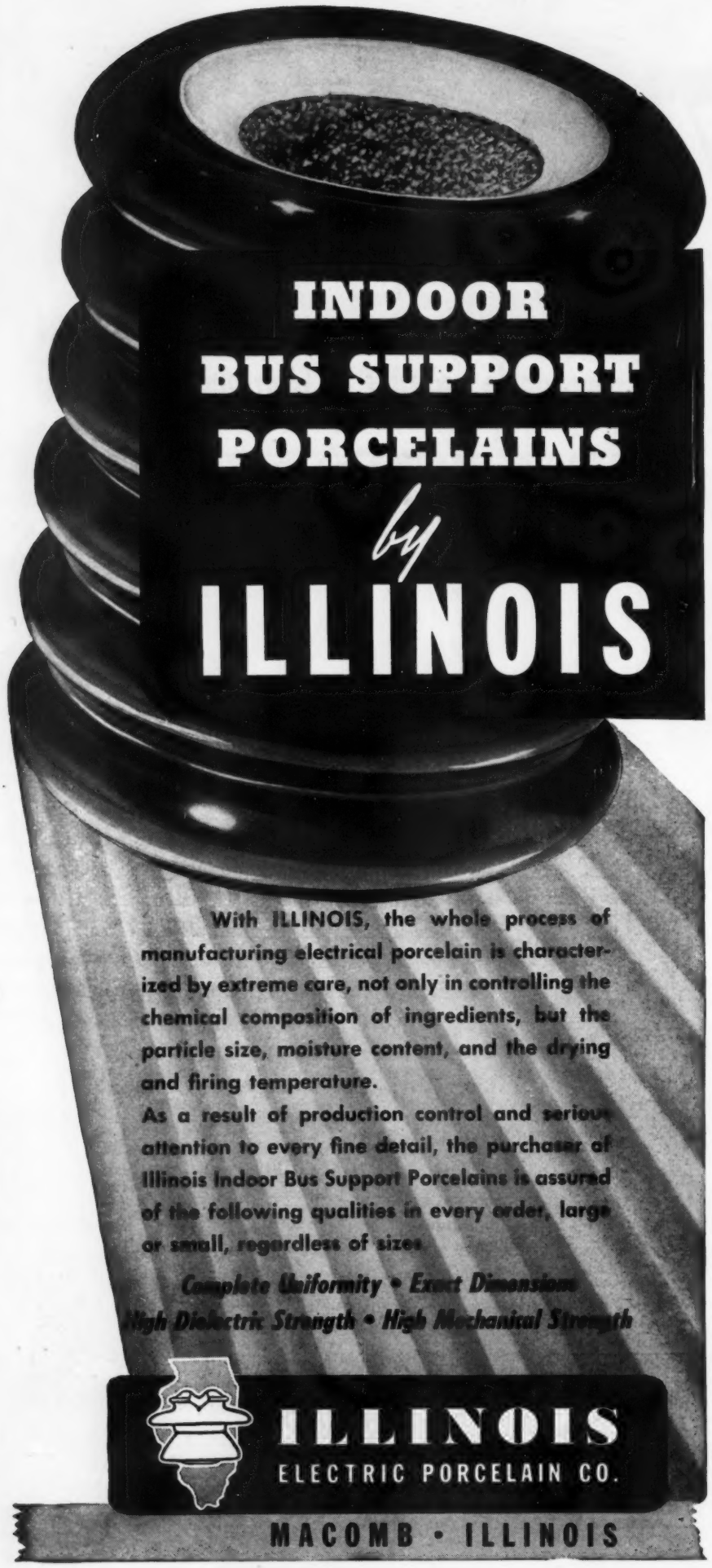
CHECK THESE OUTSTANDING FEATURES:

- 0.3 class accuracy for burdens B-0.1 through B-0.5.
- Hipersil* core steel for light weight, small size and greater metering and relaying accuracy.
- Transparent terminal blocks to place secondary connections within easy observation.
- Automatic short-circuiting devices to protect personnel from induced high open-circuit voltages.
- EEI-NEMA standard mounting dimensions.

**Registered U.S. Trademark*

Westinghouse
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

YOU CAN BE SURE IF IT'S Westinghouse


INDOOR
BUS SUPPORT
PORCELAINS
by
ILLINOIS
With ILLINOIS, the whole process of manufacturing electrical porcelain is characterized by extreme care, not only in controlling the chemical composition of ingredients, but the particle size, moisture content, and the drying and firing temperature.
As a result of production control and serious attention to every fine detail, the purchaser of Illinois Indoor Bus Support Porcelains is assured of the following qualities in every order, large or small, regardless of sizes
Complete Uniformity • Exact Dimensions
High Dielectric Strength • High Mechanical Strength
ILLINOIS
ELECTRIC PORCELAIN CO.
MACOMB • ILLINOIS

the class to be used. Due consideration is given foreign attachments. For this purpose the accompanying table gives the minimum class requirements in heavy loading districts for various span lengths based on the number of No. 4 weatherproof wires or equivalent to be installed. Factors are also given to convert other wire sizes on a pole to No. 4 equivalent before using the table. Also included are factors by which each telephone attachment is to be multiplied, depending on the height of pole to be used.

Pole Class for Various Spans and Wire Loadings

No. of Wires	Span Length in Ft 100	125	150	175	200	250	300
2	5	5	5	5	5	5	5
4	5	5	5	5	5	5	5
6	5	5	5	5	5	4	4
8	5	5	5	5	4	3	2
10	5	5	4	4	3	2	1
15	4	4	3	2	1	—	—
20	3	2	1	1	—	—	—
25	2	1	—	—	—	—	—
30	1	—	—	—	—	—	—
35	1	—	—	—	—	—	—

The following multipliers are used to convert all wire sizes on a pole to No. 4 equivalent:

Multiply the number of		
No. 6 wires by		0.96
No. 4		1.00
No. 2		1.05
No. 0		1.10
No. 2/0		1.17
No. 4/0		1.30

Multiplying factor for telephone attachments:

Type of Attachment	Height of Pole in Ft 30	35	40	45
0.104 wire	0.64	0.53	0.45	0.35
3/8-in strand and cable	2.56	2.13	1.80	1.58
7/16-in strand and cable	3.21	2.66	2.25	1.97
1/2-in strand and cable	3.85	3.20	2.70	2.36

Type of Pole Needed

EXAMPLE: To determine the class of pole required to support the following TBWP copper wires and strand carrying telephone cable: Four No. 4/0 primaries; four No. 2 primaries; four No. 6 street lighting wires; three No. 2 secondaries; one 10,000-lb strand ($\frac{7}{16}$-in.) telephone cable messenger. Height of pole, 40 ft; span length, 125 ft.

		Wires
Four No. 4/0 primaries	4 x 1.30	5.20
Four No. 2 primaries	4 x 1.05	4.20
Four No. 6 street lighting	4 x 0.96	3.84
Three No. 2 secondaries	3 x 1.05	3.15
One 7/16-in strand and cable	1 x 2.25	2.25
Total		18.64

The next highest number of wires shown in the table is 20, which for a 125-ft span requires a Class 2 pole for use on the power system.

Already acclaimed by an ovation of orders!

THESE NEW TWIN TRIUMPHS OF PRECISION-PLANNED LIGHTING:

LENOX-2*
LENOX-4*

And no wonder! After two years of exhaustive research, Day-Brite has engineered into these superb fixtures all the features you want most.

Greater efficiency . . . more ease and economy of installation and maintenance . . . smarter functional styling . . . added flexibility of application . . .

they're **all** yours in the versatile LENOX-2 and LENOX-4.

HIGHLIGHTS OF THE NEW LENOX "TWINS":

- Two 40-watt lamps (LENOX-2) or four 40-watt lamps (LENOX-4) in matching fixtures engineered for low brightness ratios . . . easier-than-ever vision.
- Ceiling or suspension mounting . . . singly or in continuous runs.
- Rugged, rigid *all-steel* precision-built construction.

Send today for the complete LENOX story, including detailed installation and performance data.

409

IT'S EASY TO SEE WHEN IT'S

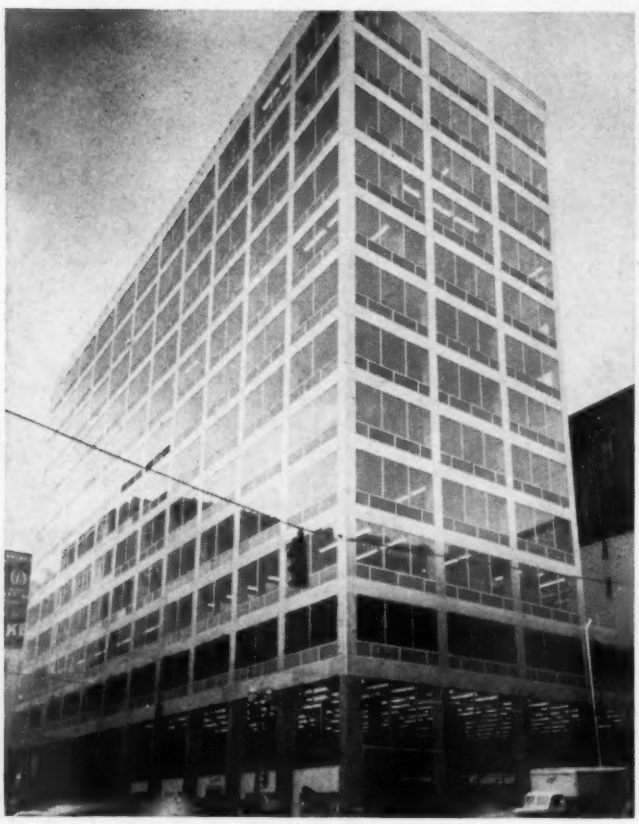
DAY-BRITE *Lighting*

Day-Brite Lighting, Inc., 5425 Bulwer Avenue, St. Louis 7, Mo.
Nationally distributed through leading electrical supply houses.

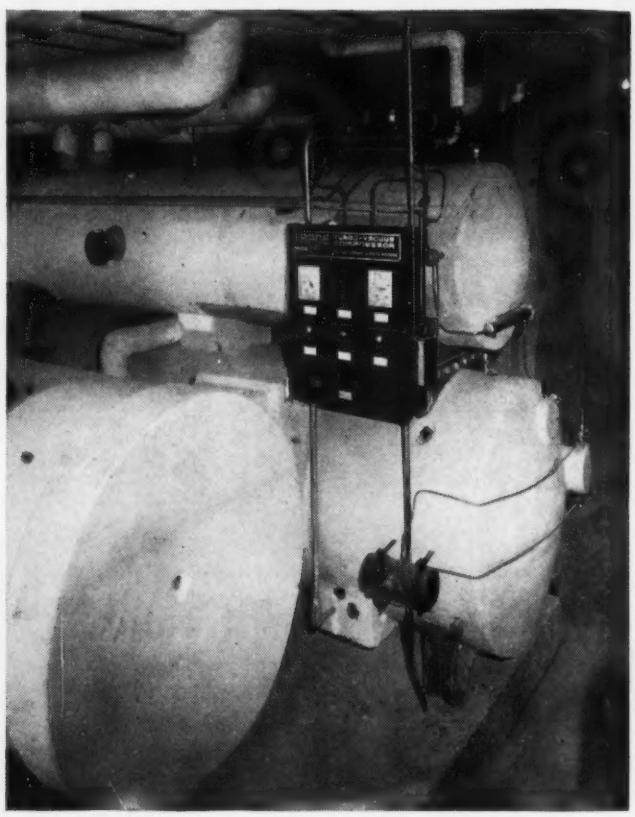
In Canada:
Address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ontario

*T. M. Reg. U. S. Pat. Off., Patents Pending

LOAD BUILDING



HEAT PUMP provides year-around air conditioning for West coast office building with aluminum-glass exterior. Heat source is water drawn from two wells and discharged into a third



ONE OF FOUR axial-flow compressors comprising heat pump installation. First cost was slightly more but operating cost is expected to be half that of any all-year air conditioning

540-Ton Heat-Pump Air Conditions 12 Story Building

ONE OF THE LARGEST heat pump installations in the U. S. is a 540-ton reverse cycle system for heating and cooling the new 12-story Equitable building in Portland, Ore.

Source of heat is water obtained from three wells at corners of the building. Two are 160 ft deep, the third, 510 ft. Four axial-flow compressors comprise the heat pumps. Two are 200-ton machines, each driven by two 100-hp motors. Each drives centrifugal impellers that are totally enclosed in the large insulated drums and directly in the Freon stream. The other two are 70-ton machines each with two 35-hp motors. Power required for compressors, pumps, and fans is 750-hp.

The building is 85% glass surface with double-glazed, column-to-column windows flush with the building faces. The rest is aluminum facing. Aluminum was also used extensively inside, such as for air ducts. Both warm and chilled water are piped to the upper floors where heating and cooling of circulating air is accomplished by blowing the air over coils. Switchover from heating to cooling, or the reverse, as well as complete instrumentation, is automatic.

A high overall coefficient of performance is expected because of design features that recover and utilize almost every possible Btu. Use of waste water to heat ventilating air is the principal factor. Another factor is an 80-ton base cooling load imposed even in winter by inside offices without window exposure. Chilled water used for this air cooling is reused to preheat the cold outside air drawn in for the heating system. During parts of the year, cooling is required in the southern exposures of the building at the same time that heating is needed in the north portion of the building. Under this condition the cooling costs nothing, thus raising the job COP. For the heat pump alone, without auxiliaries, the COP is 4.3; with auxiliaries, 3.7.

Cost of the system for a design temperature of minus 10F was about comparable to steam and the refrigeration required for complete year-around air conditioning. Operating cost is expected to be only about half that of anything competitive. Maxi-

New CHANCE 8-way Expanding Anchor

Here is another answer to the problem of rapidly rising line construction costs! The new Chance 8-way Expanding Anchor gives you more holding power for less money.

Better load distribution makes this new Chance Anchor stronger than other expanding anchors — and the absolute simplicity of its construction makes it the most smoothly operating expanding anchor on the market.

C4816

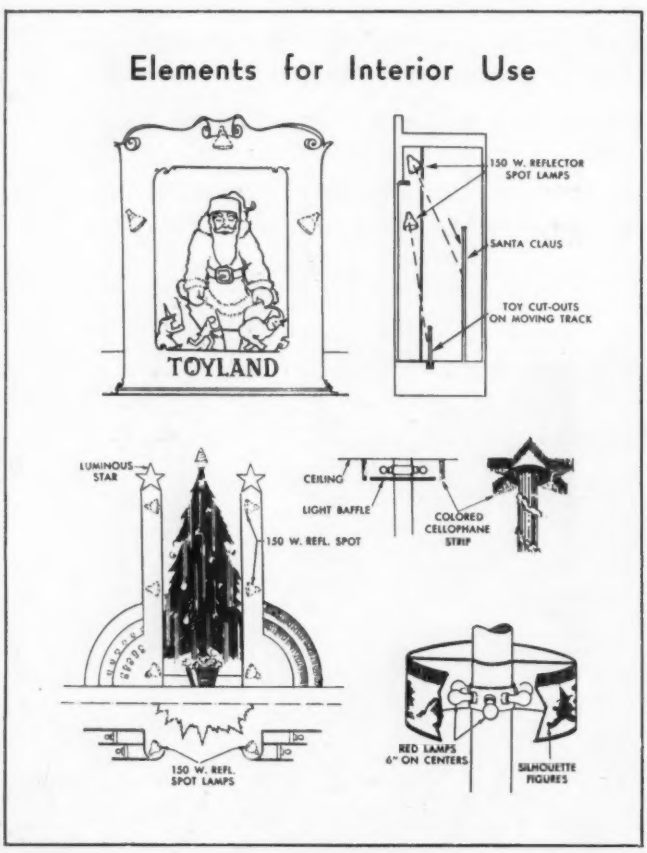
CENTRALIA, MO., SAN FRANCISCO, CAL.

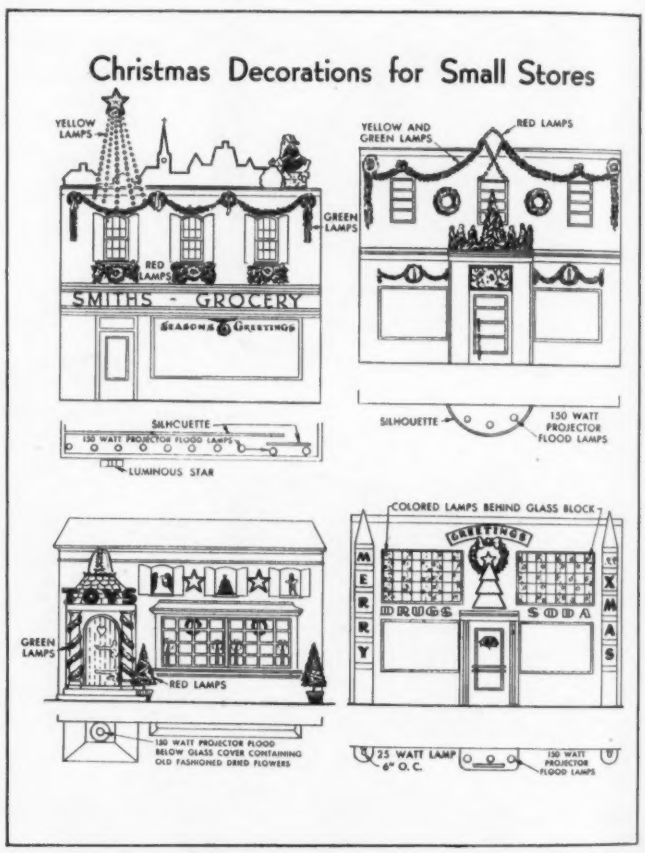
ABC INDUSTRIES

mum yearly demand for the entire 212,000-sq ft, 2,275,000-cu ft, building is estimated to be 962 kw, occurring in August. Average demand for the year is estimated at 836 kw. Estimated annual consumption is 2,588,792 kw-hr; annual bill $20,831. Annual load factor would be 40% on a demand of 836 kw.

Portland General Electric Co serves the building from two 750-kva underground transformer banks through a 4,000-amp, 120/208-v main service bus. A 2,475-amp tubular vertical copper bus for light and power and for elevators at the roof, runs up through the building. Cold cathode lighting is used throughout the building. Recording ammeter charts taken on the main service by the power company showed an ideal load, with a balanced load of 1,200 amp all through the night and a very constant load during daylight hours.

Christmas Decorations





SUGGESTIONS for Christmas decoration of business streets and of store exteriors, interiors and windows, together with diagrams showing design and construction of decoration elements, have been assembled by the Westinghouse Lamp Division. They are contained in 14 sheets of sketches similar to those above and are available to lighting salesmen and others looking for ideas for holiday displays

Germicidal Lamps Effective In Poultry Care

FRED VOSE
Rural Service Representative
Consumers Power Company

GERMICIDAL LAMPS have been found very effective in poultry care. In a local experiment, 12 day-old chicks and a mother hen were placed in a 6 x 9 ft room completely shut off from sunlight.

To replace natural daylight, a 25-w incandescent and a 15-w germicidal lamp were installed. After 12 weeks, the chicks averaged three pounds and two ounces. Five of the original chicks are pullets and are currently laying an average of four eggs per day.

While the experiment was in progress, a young turkey with rickets and a bad cold was placed in the room. Its legs were not strong enough to support its own weight. During the first week, the turkey lost one-half pound; during the second, it maintained its four pounds; during the third, it started to gain and rapidly approached normal. Its legs are now straight and strong.

The chicks and the mother hen, although in the same room, did not catch the cold germs from the turkey. The only particular precaution taken was to clean the germicidal lamp every day so that dust particles would not obstruct the energy-producing rays.

only FEDERAL NOARK CONTROL CENTERS have *ALL* these features

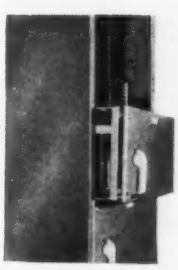
Because Federal NOARK Control Centers are COMPLETE . . . they're *easier* to buy, install, extend, rearrange, relocate, and service!

For details . . .
contact the Federal NOARK District Office.

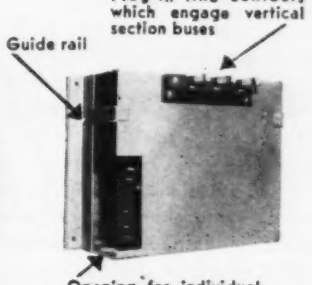
Removable cover over Main Bus and top horizontal cable trough
Removable cover over master terminal board compartment
Combination removable line starter units
Starters size #1 to #4 inclusive designed in multiples of a fixed dimension to provide maximum flexibility.
Space for future starter
Removable cover over bottom cable trough
Removable cover for extension of top horizontal cable trough when additional sections are added. These covers are on both sides of sections.
Removable cover for extension of main bus when additional sections are added. These are on both sides of sections.
Designed so that one vertical section can accommodate sizes #1 to #4 starters.
Bottom cable troughs with cover removed

Same vertical section used for front mounting or back-to-back arrangements.

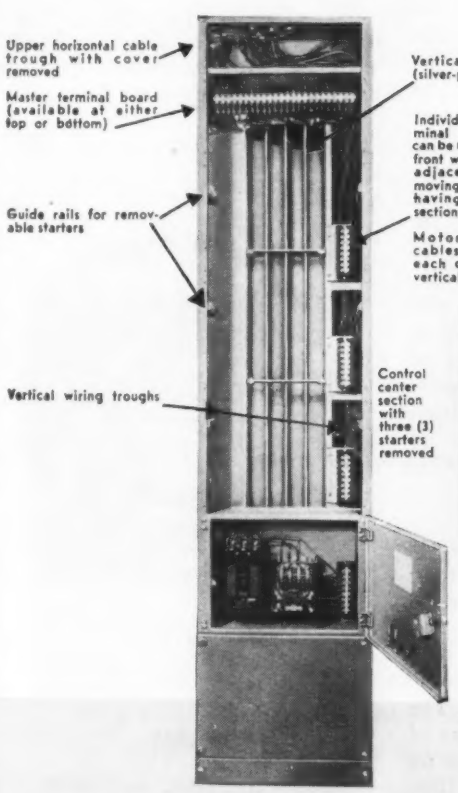
Size #1 to #4 starter. Line plug eliminates necessity of shutdowns or working "hot" connections to remove starters



View showing removable starter unit partially removed and being supported by its channel guides



Rear-view of removable combination line-starter unit


Upper horizontal cable trough with cover removed
Master terminal board (available at either top or bottom)
Guide rails for removable starters
Vertical wiring troughs
Vertical section buses (silver-plated)
Individual starter terminal boards. Starters can be removed from the front without disturbing adjacent starters, removing rear plates, or having loose wires in section.
Motor and control cables isolated from each other and from vertical buses.
Control center section with three (3) starters removed

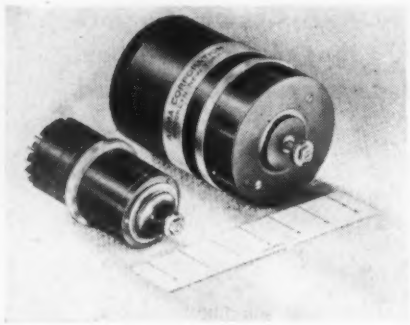
Federal NOARK Control Centers

Executive Offices: 50 Paris St., Newark, N. J.
Plants: Hartford, Conn.; Newark, N. J.; St. Louis, Mo.; Long Island City, N. Y.

Sales Offices in Principal Cities

Federal Electric Products Company, Manufacturers of a Complete Line of Electrical Products, including Motor Controls • Safety Switches • Service Equipment • Circuit Breakers • Panelboards • Switchboards • Bus Duct

NEW EQUIPMENT



Electrical Resolvers

A LINE of electrical resolvers designed specifically for electromechanical computing and control equipment is announced by Arma Corp, 254-36th Street, Brooklyn 32, N. Y. They were developed primarily as parts of Navy instruments and are now available to industry generally.

The resolvers are claimed to be an accurate and dependable means of solving problems involving the trigonometric functions. Each is designed to deliver two alternating voltages proportional respectively to $e_1 \sin A$ plus $e_2 \cos A$ and $e_1 \cos A$ plus $e_2 \sin A$, where e_1 and e_2 are the voltages applied to the two primaries and A is the angle through which the rotor has been turned from the position defined as electrical zero. The line includes various types of the two sizes illustrated.

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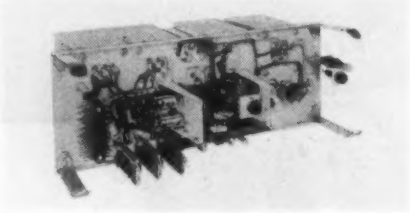


Carrier System

A THREE-CHANNEL short-haul carrier system, designated the FTR 9-H-1, has been developed by Federal Telephone and Radio Corp, 100 Kingsland Road, Clifton, N. J. Through the use of this equipment, three additional telephone circuits can be obtained between field locations and headquarters office.

As a result of the fact that the unit was designed for short-haul systems (50 to 150 miles maximum) it is claimed that equipment economies can be effected without any deterioration in transmission quality characteristics. The manufacturer advises that this system can be installed for lines as short as 5 miles.

The carrier system equipment occupies 7 in. of vertical rack space per channel and weighs 35 lb. The transformers, coils, filters, and capacitors are hermetically sealed and mounted on the rear of the panels.

It is possible with this equipment plus the FTR 9-C-1 Speech-Plus-Duplex carrier telegraph equipment to add three voice and six telegraph channels on existing telephone lines.

•

Radio Interference Filter

A NEW CAPACITOR TYPE FILTER to control radio interference caused by fluorescent lamps has been announced by Cornell-Dubilier Electric Corp, South Plainfield, N. J. This filter is stated to be suitable for use on other types of electrical equipment.

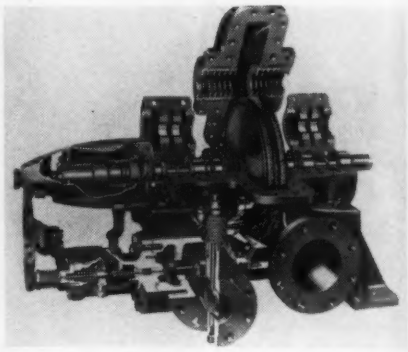
Filter type NF-1A149, designed to meet the requirements of the Certified Lamp Manufacturers Association, is connected across the hot cathode of fluorescent lamps, both straight and circular in shape. It is $\frac{7}{16}$ in. in diameter and $1\frac{5}{8}$ in. in length. Rated at 330 v ac, the unit has a capacity of 0.006 mf. The oil impregnated capacitor element is wax sealed in an insulated housing.

•

Steam Turbine

A GENERAL-PURPOSE turbine for driving industrial pumps, fans, blowers, compressors, paper machinery, and small generators, the TYPEE, has been announced by the Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa. The turbine can be applied over a range of 5- to 1500- hp with steam conditions up to 600 psig at 750 F, and speeds of 1000 to 7000 rpm. Equipped with heavy duty parts the turbine will operate at 1500 psig at 950 F. Many parts are interchangeable between wheel sizes.

Combination felt and labyrinth bearing seals are included to protect the turbine's lubricating system from contamination so that neither torrential rain



nor the presence of abrasive dust will affect its operation. Corrosion resistant materials are used liberally throughout.

An overspeed trip simultaneously closes the governor valve and a heavy butterfly valve at a predetermined speed. Improved free-expansion center line support is arranged so that pipeline reaction is transmitted to the foundation.

The basic turbine is equipped with a shaft type governor, mounted in a casing that completely protects the governor assembly and shaft end.

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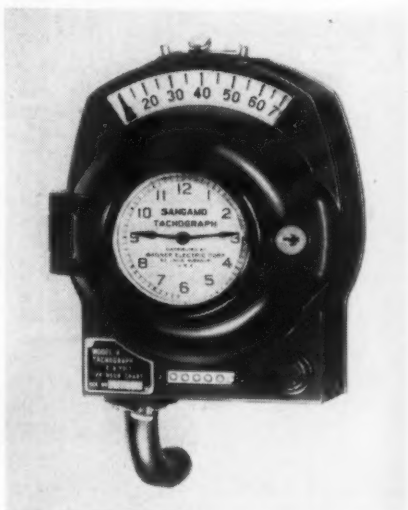


Speed Recorder

FOR AUTOMOTIVE equipment a recording instrument known as a Tachograph has been developed by Sangamo Electric Co and is being distributed by Wagner Electric Corp, St. Louis 14, Mo. Mileage, speed, operating and idling time can be recorded on 12 or 24-hr circular charts.

The unit has four aids to drivers—

HUBBARD GUY CLAMPS

1. The *straight groove* eliminates the possibility of drawing a nut tight against an "arched" section which is out of contact with the strand. Hubbard Clamps have full clamping area. Hold to breaking strength of most strands.

2. The *straight groove* fits any and all twists, right or left hand and a variation in diameter without *creating* any high spots to *lessen clamping area.*

3. Bell-end grooves prevent injury to the strand caused by the sharp corners at the ends of the grooves of some clamps.

4. High carbon bolts prevent stripping or elongation. Heads are locked against turning while tightening—and the whole clamp is protected against corrosion by the best process commercially used—HUBBARD DOUBLE-DIP HOT GALVANIZING.

5. The range of strand sizes accommodated by No. 7461 Guy Clamp, without sacrifice of holding strength in any size, can not be matched by any other style of clamp. Exhaustive tests have been made on specially designed clamp sections, patented shapes and various snubbing ideas, all of which have failed to measure up to the HUBBARD straight, smooth groove type of clamp.

HUBBARD AND COMPANY

PITTSBURGH CHICAGO **OAKLAND, CALIF.**

3 PEOPLE PROFIT

by using
WHEELER BRICK-TYPE BALLASTS

THE MANUFACTURER

of fluorescent lighting fixtures profits through the good basic design and engineering, skilled manufacture and rigid inspection of Wheeler Brick-Type Ballasts in his product. He is thus assured of rated light output, full lamp life and trouble-free performance.

MAINTENANCE MEN

profit through fewer, less frequent replacements in their fluorescent lighting installation. If their fixtures are equipped with Wheeler Brick-Type Ballasts, they'll devote less time to annoying and costly replacement jobs.

THE WHOLESALER

will profit by stocking Wheeler Brick-Type Ballasts. Maintenance men, lighting repair and installation people and other ballast customers will appreciate the availability of a dependable, quality ballast. Satisfied customers mean more profit — through purchases of ballasts and other components.

WHEELER BRICK-TYPE BALLAST

Available for the operation of two lamps in the following ratings: 40 watt 118 volt 60 cycle, certified by Electrical Testing Laboratories, Inc.; also for 220 volt 50 cycle and 220 volt 60 cycle. These ballasts are built to rigid specifications by Wheeler craftsmen. All are approved by Underwriters' Laboratories.

WRITE TODAY FOR COMPLETE BALLAST INFORMATION

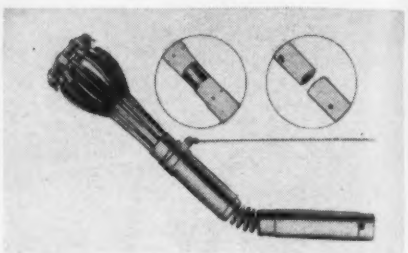
THE WHEELER INSULATED WIRE CO., INC.

SERVICE QUALITY WHEELER DEPENDABILITY

DIVISION OF THE SPERRY CORPORATION
1310 WASHINGTON AVENUE
BRIDGEPORT 4, CONNECTICUT
MAGNET WIRE • COILS • COMMUNICATIONS EQUIPMENT

an illuminated speedometer at top, clock, excess speed signal light in lower right corner, and mileage odometer at bottom. Mounting can be on the dash or a bracket. Flexible cable connection (at elbow) is made to the transmission take-off. Electrical connection is made into the ignition and dashlight circuits. Chart is mounted in the door at rear of clock.

•



Lamp Changer and Pole

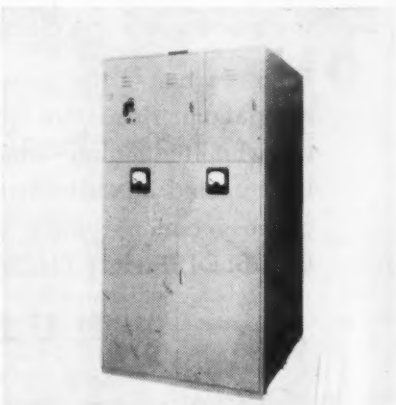
AN IMPROVED type of pole with an adaptable lamp changer is made available by McGill Manufacturing Co, Inc, Dept LC, Valparaiso, Ind.

This new lightweight steel pole is furnished in 5½-ft interchangeable sections. The sections may be joined together to provide a pole up to a recommended limit of 30 ft. Sections are locked together by a spring actuated button which also permits quick disassembly. Each section is reported to be insulated for protection against shock from exposure or contact of changing pole or head to live wires.

•

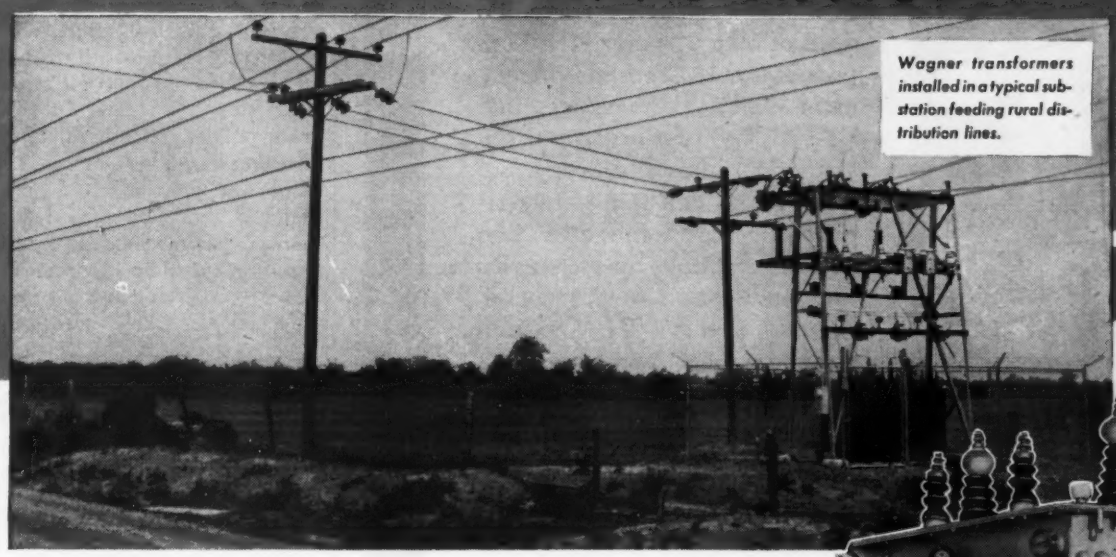
Low-Voltage Controllers

A NEW LINE of low-voltage controllers for use with a-c motors up to 800 hp (at 550 v) and for d-c motors up to 350 hp (at 230 v), has been announced by Control Division, General Electric Co, Schenectady 5, N. Y. These new dead-front metal-enclosed controllers are designed for controlling squirrel-cage, wound-rotor, synchronous, or multi-speed a-c motors, or d-c motors. Common applications for which they



THEY'RE PART OF THE PICTURE...

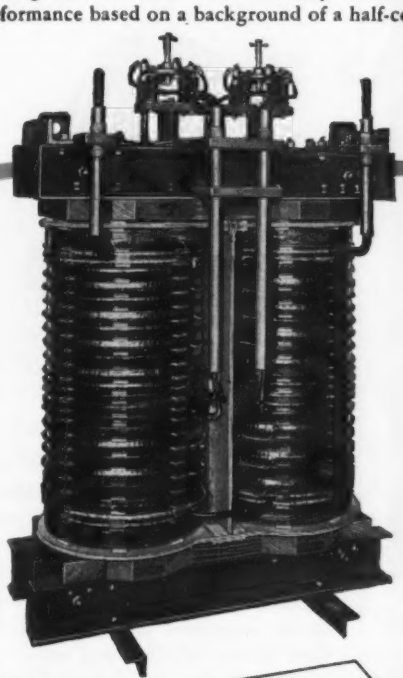
Wagner Substation Transformers for RURAL APPLICATION



Wagner transformers installed in a typical substation feeding rural distribution lines.

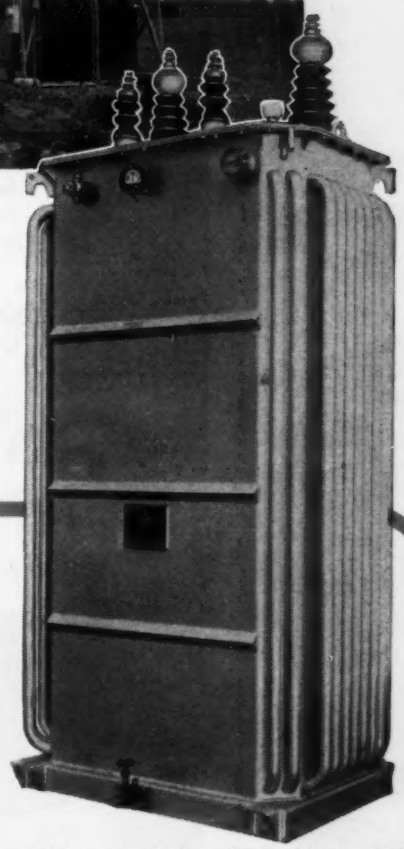
WAGNER builds a complete line of oil-filled, self-cooled transformers for substation operation on distribution systems. Hundreds of these transformers are supplying many of the rural-line systems in operation throughout the country. They are available in all standard kva and voltage ratings with standard accessories.

Wagner transformers are nationally known for their high standard of quality and performance based on a background of a half-century of designing and building distribution and power transformers. Trained field engineers in our 29 branch offices, located in principal cities, are ready to help solve your Rural-Line Transformer problems.



Pictured at right is a 500 kva 46000 to 7200 volt, type HEL transformer. These units are available in sizes 150 to 500 kva in standard voltage combinations up to 69 kv.

The element, shown at left, is a typical core-type element, like those generally used in transformers of this classification. Note its simple design and sturdy construction . . . built for years of rugged service.



Bulletins TU-180 and TU-181 give full information on Wagner Substation Transformers. Write for your copies.

Wagner Electric Corporation
6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

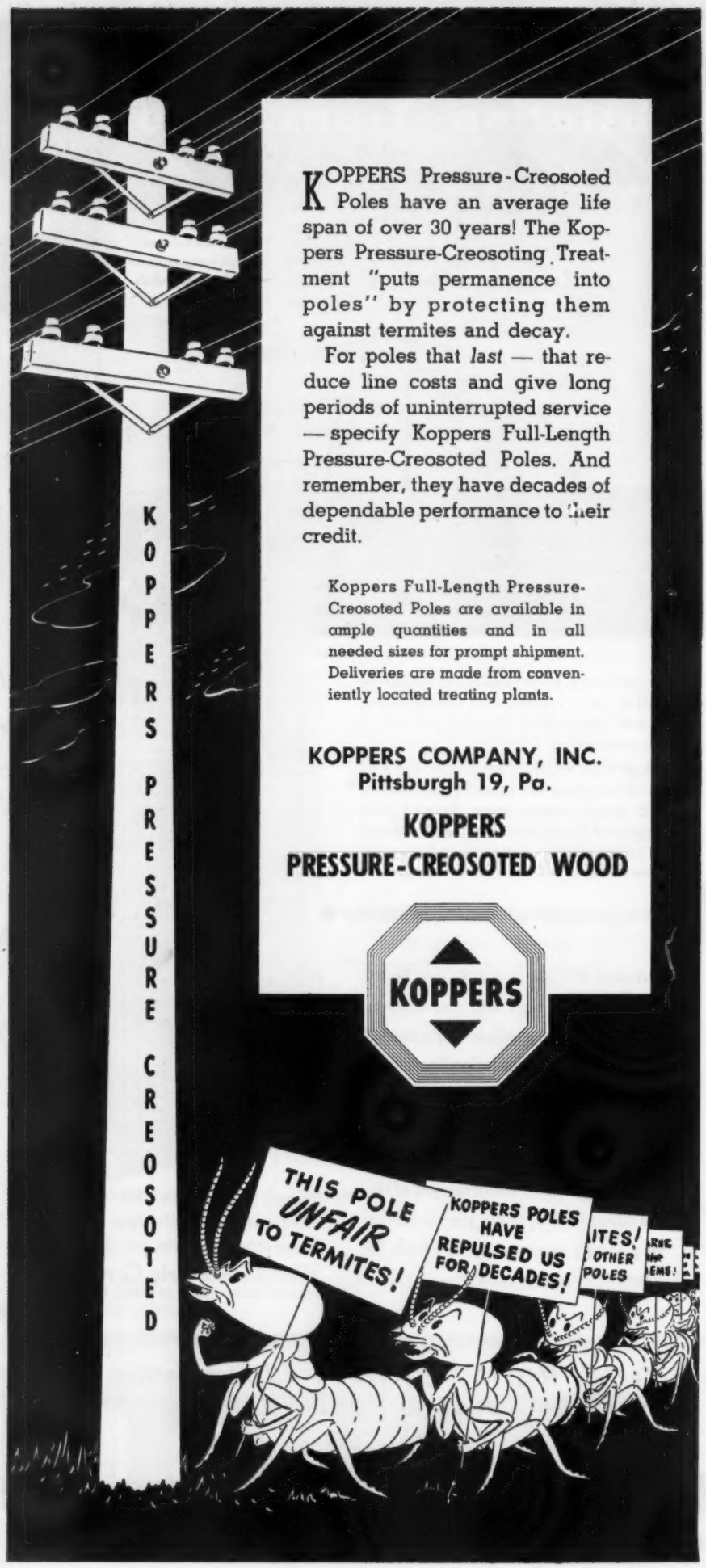
Wagner Electric Corporation EST. 1891

Consult Wagner Engineers on All Transformer Problems

T48-10

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS


KOPPERS PRESSURE CREOSOTED
KOPPERS Pressure-Creosoted Poles have an average life span of over 30 years! The Koppers Pressure-Creosoting Treatment "puts permanence into poles" by protecting them against termites and decay.
For poles that last — that reduce line costs and give long periods of uninterrupted service — specify Koppers Full-Length Pressure-Creosoted Poles. And remember, they have decades of dependable performance to their credit.
Koppers Full-Length Pressure-Creosoted Poles are available in ample quantities and in all needed sizes for prompt shipment. Deliveries are made from conveniently located treating plants.
KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.
KOPPERS
PRESSURE-CREOSOTED WOOD
KOPPERS
THIS POLE UNFAIR TO TERMITES!
KOPPERS POLES HAVE REPULSED US FOR DECADES!
OTHER POLES

are suitable are pumps, mixers, grinders, mills, and similar drives in the heavy industries.

The new controllers are 90 in. high. They include in one unit the equipment to start, stop, and control such motors, and in addition include an integrated draw-out air circuit breaker which provides short-circuit protection (either 25,000 or 50,000 amp).

Serving also as a circuit isolating device, this draw-out air circuit breaker is designed so that it is readily interchangeable. In addition, when the breaker is pulled out to the inspection and test position, it is mechanically latched and disconnected from all power. A mechanical interlock trips the breaker when it is removed from its unit. Unless breaker is in operating or inspection and test positions, mechanical interlocks prevent closure.

•

8-Way Anchor

In designing a new 8-way steel expanding anchor, the non-holding area between blades has been eliminated according to the manufacturer, A. B. Chance Co, 210 Allen St, Centralia, Mo.

Controlled by a blade stop, the eight-blade, one-piece top plate expands to form a conically shaped square, which distributes the anchor's holding power over a wide area. Each of the ribbed blades is required to carry approximately one eighth of the total load.

The metal-to-metal sound of the expanding top plate striking the blade stop indicates when the anchor is fully expanded. A nut retainer on the bottom of the base plate enables the user to salvage rods and makes it easy to push the anchor into the hole.

Safe Street Lighting Pays

—IN CANCELLED ACCIDENTS

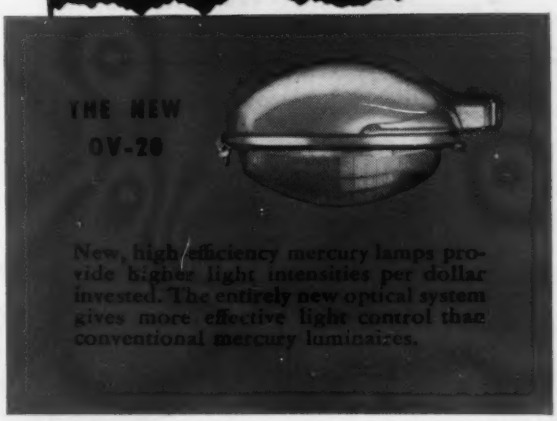
The cost of traffic accidents is the largest item in street maintenance. The economic waste from automobile accidents in this country exceeds $1,250,000,000 annually . . . and 60% of the traffic fatalities occur at night.

How can we handcuff America's No. 1 public killer and cancel a large percentage of these accidents? The answer is *planned street and highway lighting.* It is estimated that for $2.40 per capita an adequate Traffic Safety Lighting Program can be inaugurated.

Call your local Westinghouse Distributor for information about street lighting. *A Westinghouse Sales Engineer will gladly co-operate with you and your electrical contractor in the development of a plan.*

J-04205

YOU CAN BE SURE
IF IT'S Westinghouse



New, high efficiency mercury lamps provide higher light intensities per dollar invested. The entirely new optical system gives more effective light control than conventional mercury luminaires.

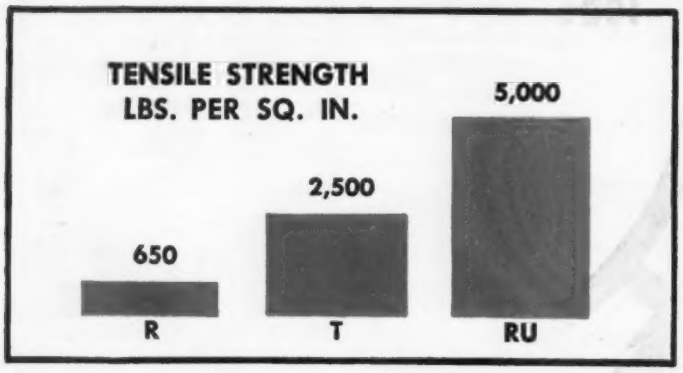
COMMERCIAL • INDUSTRIAL • FLOOD • STREET • AVIATION

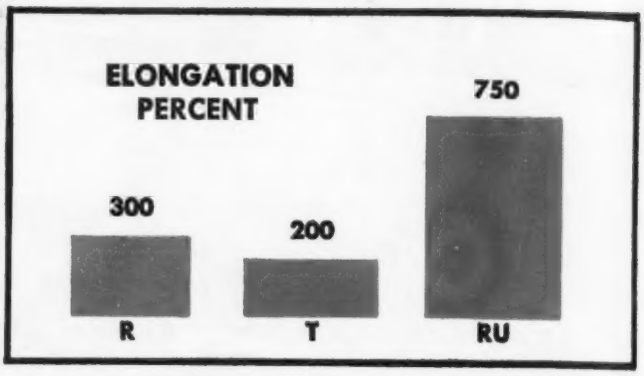
Westinghouse Planned Lighting *Pays*

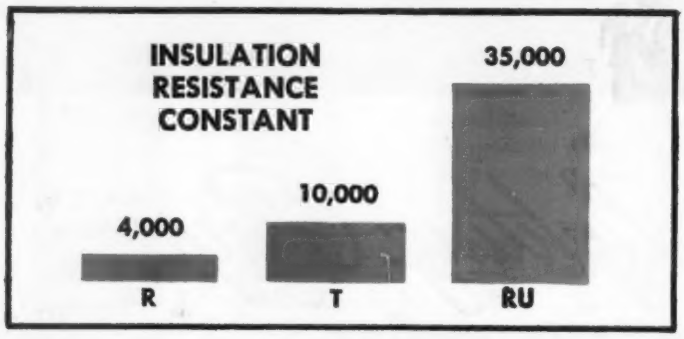
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

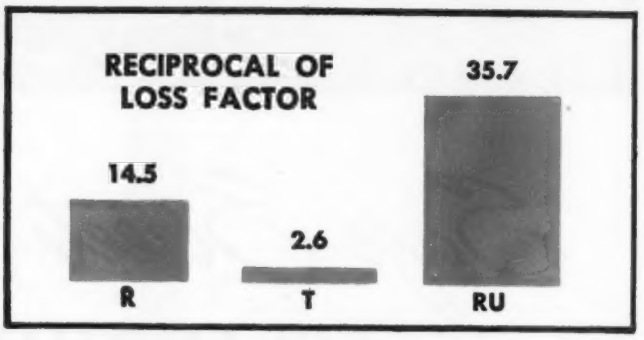
SMALLER DIAMETER CONTROL CABLES INSULATED WITH *Laytex**

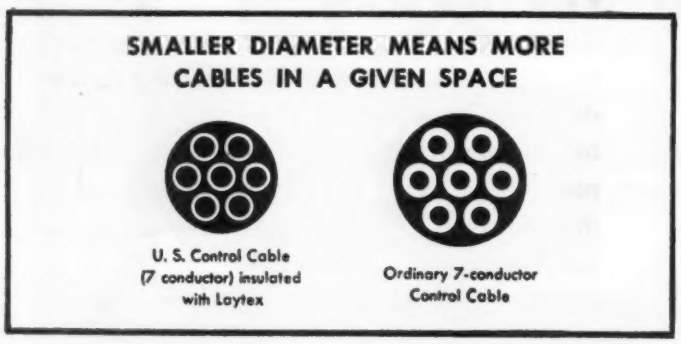
COMPARE *Laytex* ELECTRICALLY AND PHYSICALLY











Three common types of insulation used on the conductors of control cable are:

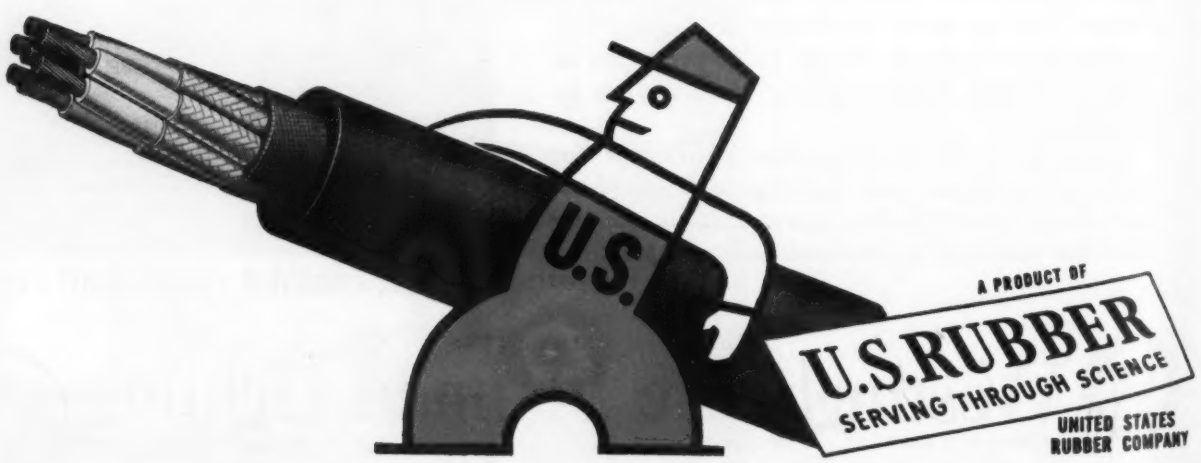
Type R—The copper conductor has a code rubber insulation.

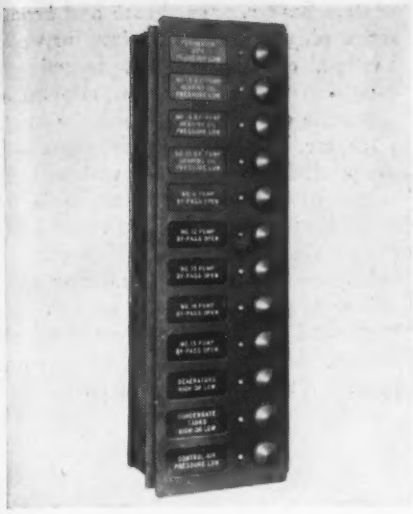
Type T—A copper conductor with thermoplastic (a synthetic compound) insulation.

Type RU—LAYTEX. This type has a copper conductor, *natural rubber insulation.*

The charts above show the wide margin by which LAYTEX leads in physical and electrical qualities. It is one reason why U. S. Control Cables will continue, as in the past 16 years, to provide the finest service obtainable. For more information, write Wire and Cable Department, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y.

**Reg. U. S. Pat. Off.*





Annunciator

NEW "single" style annunciator, measuring only 10 in. as compared with the 20-in. width of the double style, has been announced by Autocall Co, Shelby, Ohio.

Size of the designation windows remains the same, 2 x 4½ in. and the ANF(S), as it is termed, may be made up of as many designation windows as required. Featured in the ANF(S) is the unit method of construction. Each unit—one for each designation window—is a metal slide mounting two main lamps for illumination of engraved Lamacoid designation, a pilot lamp, and control relays.

In actual operation, illumination of the designation windows is accomplished by the closing of a control relay actuated by a supervisory, or "trouble" contact on the equipment under supervision. The ANF(S) can be designed to operate on any of the standard a-c or d-c voltages.

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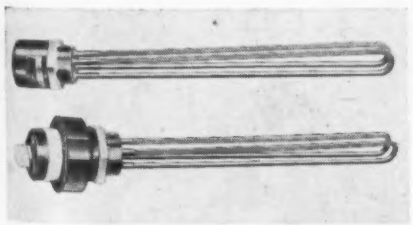
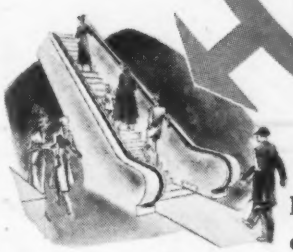


Screw-in Heaters

A NEW SERIES of Chromalox electric immersion heaters with standard pipe-threaded screw plug for easy mounting through tank walls has been announced by Edwin L. Wiegand Co, 7500 Thomas Blvd, Pittsburgh 8, Pa. The heaters are available with single- or 3-heat switch built into the terminal end, or without switch for thermostatically controlled applications.

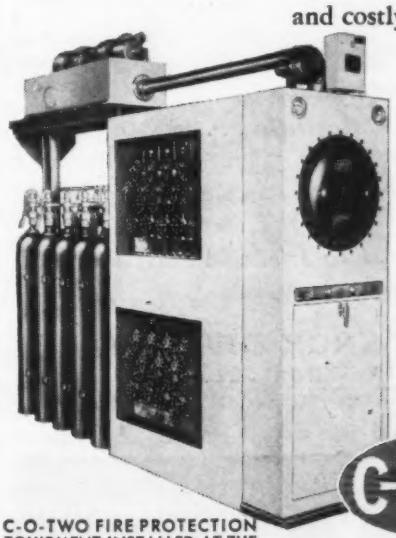
The heated sections are triangulated Chromalox tubular elements. These

C-O-Two helped a leading department store solve a fire protection problem



Fire, even a small one, can spread rapidly . . . create panic . . . loss of good will, equipment, buildings and human lives.

Twenty of the electric stairways at Marshall Field & Company in Chicago are now protected from fire by C-O-TWO. Little chance of cigarette butts, matches, overheated motors, or short circuited electrical equipment starting a disastrous fire. The C-O-TWO Combination Smoke Detecting and Fire Extinguishing System automatically detects smoke in the machinery room and the housing of these electric stairways. Upon a signal, non-damaging carbon dioxide is released into the threatened area, controlling the fire before panic and costly damage takes place.



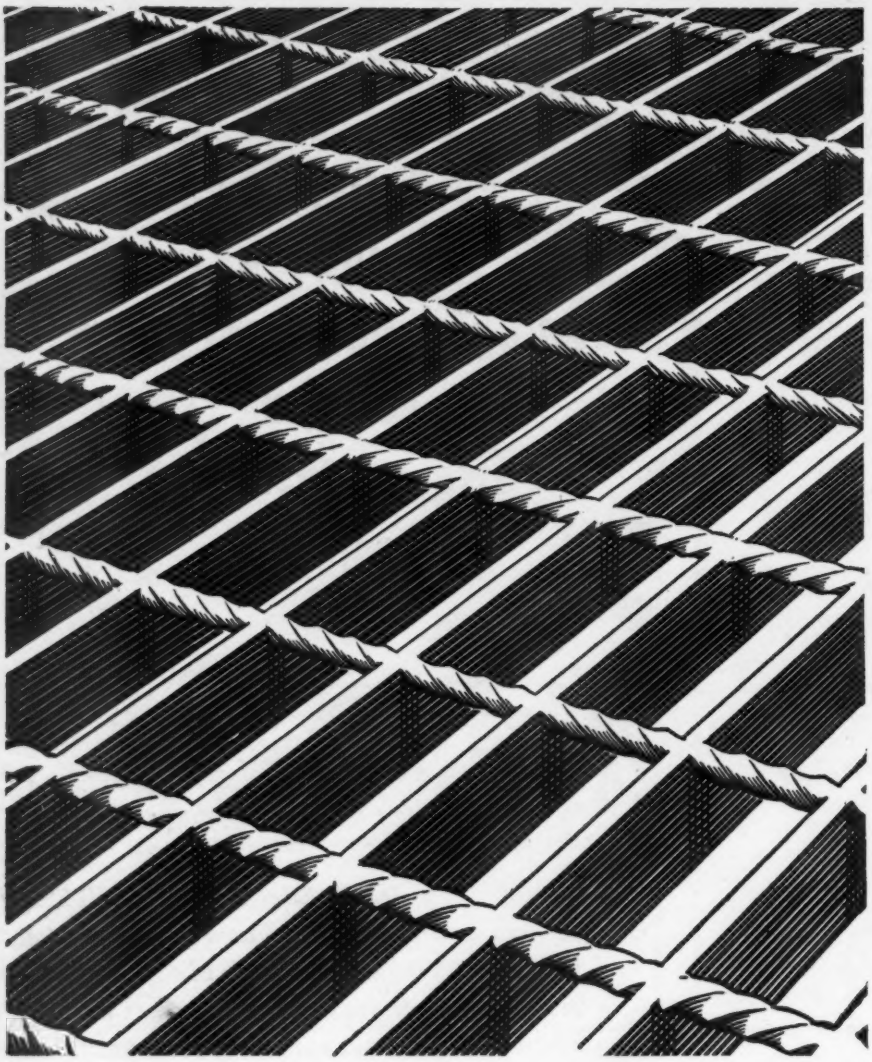
C-O-TWO FIRE PROTECTION EQUIPMENT INSTALLED AT THE MAIN FIRE STATION
left to right — carbon dioxide cylinders, blowers, control valve cabinet and smoke detecting cabinet.

Whether your fire protection problem is a store, factory, ship or power plant, an expert C-O-TWO Fire Protection Engineer can help you plan and install adequate fire protection equipment.

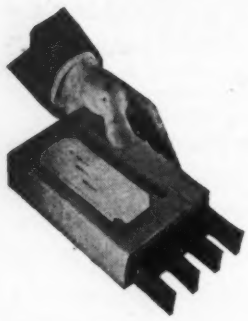
Write us today for your free copy of the test report on this installation.

C-O-TWO

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY
Sales and Service in the Principal Cities of United States and Canada
AFFILIATED WITH PYRENE MANUFACTURING COMPANY



SEE THOSE TWISTED CROSS-BARS?



They're electroforged directly *into* the bearing bars to form a rigid one-piece steel "material" of guaranteed strength—with safe footing at all times . . . Blaw-Knox Grating also —

★ *Provides Maximum Open Area* for light and ventilation

★ *Is Easy to Maintain* . . . easy to paint thoroughly

★ *Is Self-Cleaning*—no sharp angles to retain debris

★ *Economical to Install* in any size or shape

FREE...
So that you can have a "close-up" of Blaw-Knox Grating construction, write today for this "paper-weight-size sample" on your business letterhead.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2013 FARMERS BANK BLDG., PITTSBURGH 22, PA.

BLAW-KNOX ELECTROFORGED STEEL **GRATING**

heaters have copper sheath and bronze screw plug with brazed joints for water heating, or steel sheath, forged-steel plug and welded joints for mineral or vegetable oils, paraffin, oakite, asphalt, pitch, etc. Various watts per square inch are available to suit the various solutions. Alloy sheaths are available for solutions that are corrosive to steel and copper.

Heaters are available ranging from 600 w to 10 kw and the majority operate on 115 or 230 v. Screw plugs are 1¼ in. for single-element heaters and 2 in. for two-element heaters.

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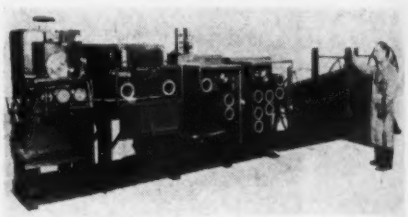

Cable Stripper

FOR SPEEDY reclaiming of cable with imperfect insulation, a new cable-stripping machine is announced by Black Industries, 1400 E. 222nd St, Cleveland, Ohio.

Referring to the illustration, the cable enters the machine at left over the rollers and under the circular knife which slits the layers of insulating materials. Depth of slit may be adjusted to avoid cutting of the interior cable. Machine is so designed that as many as three different insulating materials may be stripped from the cable, separated from each other by the series of serrated rolls, and taken up on individual reels, the cable itself being taken up separately.

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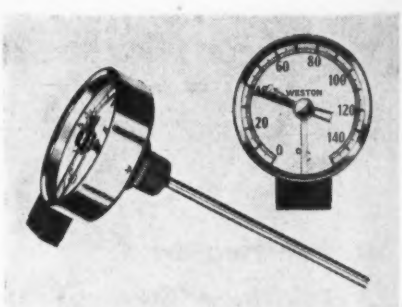
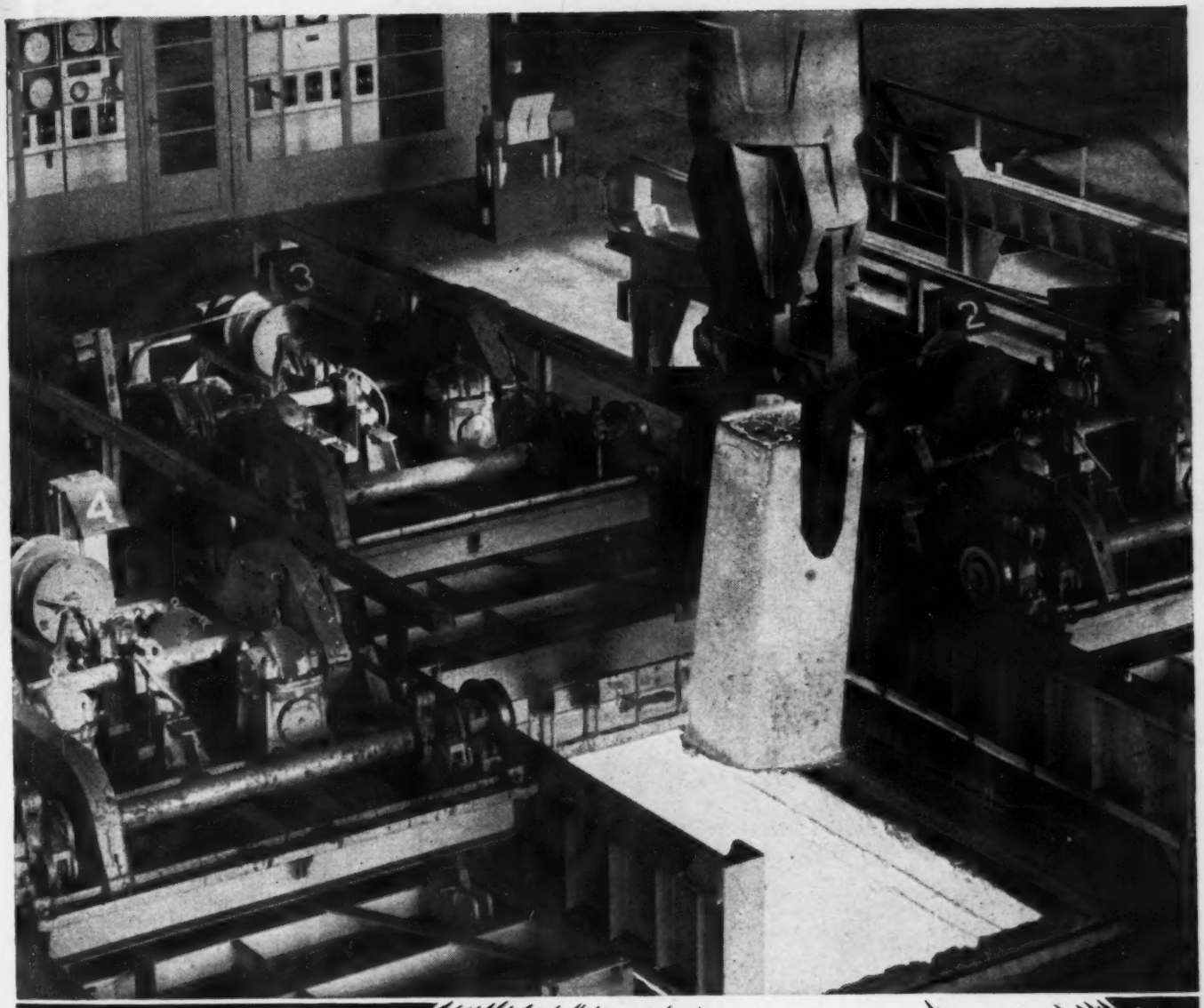


Contact Thermometer

A NEW contact-making thermometer, combining the features of an indicating thermometer in addition to an alarm or control device, has been introduced by the Weston Electrical Instrument Corp, 617 Frelinghuysen Ave, Newark 5, N. J.

The instrument consists of an all-metal thermometer with an adjustable



BE SURE OF YOUR CIRCUITS UNDER TOUGHEST CONDITIONS

—FOR INSTANCE, UNDER BAKING HEAT

This open steel mill soaking pit presents just about the best example of the worst conditions wire and cable have to work under. Power and control circuits are exposed to the blasts of white-hot heat from the pits and suspended billets—that's why they are wired with *permanently insulated* Rockbestos A.V.C.

Your maintenance-boosting circuits may not have to take such severe conditions, but you'll protect operations and save worry and work when you wire the hot spots with Rockbestos A.V.C. wires, cables and cords. Impregnated asbestos braid and felted asbestos insulation are the answer to wiring problems. Their inherent heat and flame resistance makes Rockbestos A.V.C. wires and cables *permanently dependable.*

Wherever heat and moisture, grease, oil or corrosive fumes may cause wire-failure—wire with Rockbestos A.V.C. and *insure* service.

WRITE TODAY—for your copy of the new No. 10-F Catalog, sectioned for easy reference to permanently insulated Lighting Wires, Power & Control Cables; Apparatus Wires & Cables; Switchboard, Fixture, Electronic and Magnet Wires.

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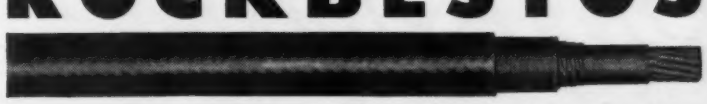
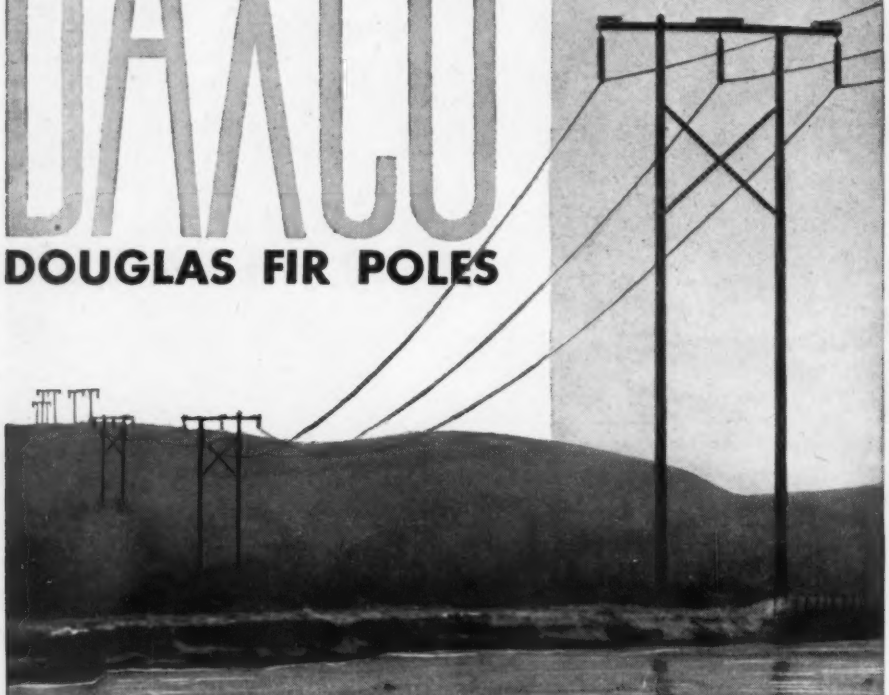


THE WIRE WITH PERMANENT INSULATION

BAXCO

LONG LIFE

DOUGLAS FIR POLES



Our specialty is long-length Douglas Fir poles, pressure treated for Long-Life service. Prompt shipments of reasonable quantities can now be made in most lengths from 60 foot to 125 foot. Direct rail shipments out of our treating plant stocks can be made to any point in the United States. Write or wire us your inquiries.

Pressure treated Douglas Fir poles have been for years the standard in pole line construction on the West Coast. BAXCO Long-Life Douglas Fir poles meet ASA Specifications and are pressure treated with coal-tar creosote or creosote-pentachlorphenol solution by the empty cell process, 8-lb. retention, in accordance with AWPA Specifications.

BAXCO Long-Life Douglas Fir poles, pressure treated from high quality Coast-type timber, will cut your maintenance costs and yield longer and more satisfactory service.

Also Produced by J. H. Baxter & Co. of Oregon—*an associated company*
Plant and Yard—Eugene, Oregon

J. H. Baxter & Co.

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contact arm mounted in the glass and bezel. A screw-type terminal block is mounted on the periphery of the case to provide for an easy electrical connection. Contacts are of the magnetic type and "break" automatically on a temperature change of about 5%.

The thermometer can be supplied to make contact on either increasing or decreasing temperature. The accuracy as an indicating thermometer is plus or minus 1%; and as a control device plus or minus 1½% of the full scale range. The instrument is available in stem length from 2½ to 24 in., with longer stems available on special order.

•

Ditch Digger

A SMALL excavating machine known as the Buckeye 401 Pony Ditcher, digs a ditch as narrow as 6 in. and is manufactured by Gar Wood Industries Inc, Findlay Div., Findlay, Ohio. Digging buckets for 8 in. are available. The unit digs to a 4-ft depth. It weighs 6580 lb and is powered by a 47-hp (at 1600 rpm) gasoline engine. Maximum length is 13 ft 9 in. and width is 4 ft 4 in. Digging speeds range from 2.19 to 14.7 fpm with digging feeds from 245 to 538 fpm.

Excavator boom is welded steel box type and is raised and lowered by means of self-locking worm hoist, powered directly from engine transmission. Spoil is discharged to both sides of ditch. Left side crawler is adjustable vertically so machine can maintain an "even keel" along a slope or with one crawler on a curb.

•

H-F Heating Units

REDESIGNED high-frequency heating units, including a new, all-steel construction of frame, base and panels, have been introduced by Lepel High Frequency Laboratories, Inc, 39 West 60th St, New York, N. Y.

They are available in 7½, 15, and 30-kw ratings, and are applicable for high-frequency heating on ferrous or non-ferrous materials.

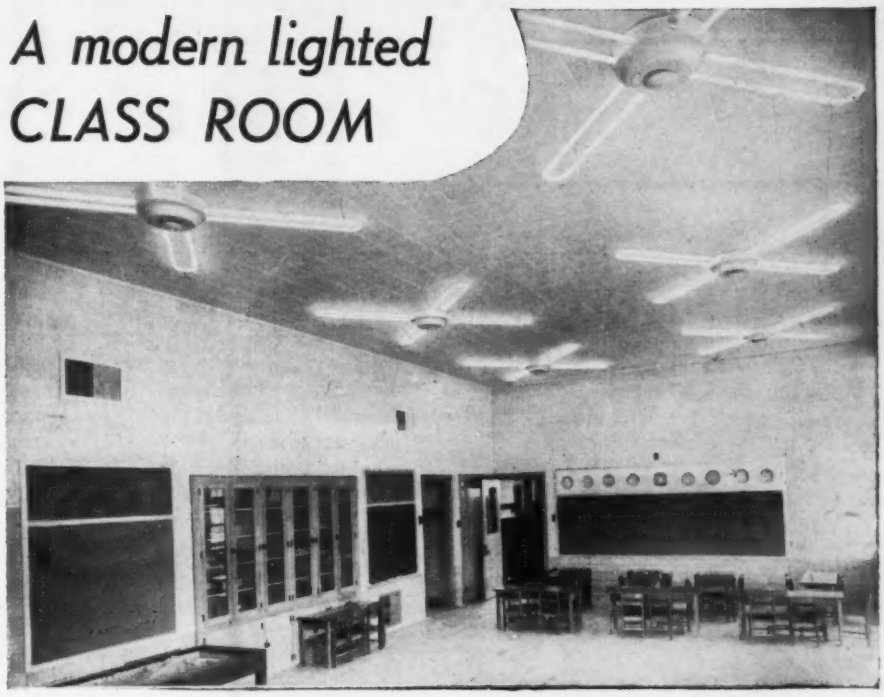
The company reports that unit interiors are of the latest fire-resisting materials, and operating controls are arranged for greater convenience. Other changes include improvements in the spark gap holders, thus reducing need for adjustment of spark gaps, and the use of fibre glass insulation in the high-voltage side of the main transformer.

MORE NEW PRODUCTS
about which you should know

Wheelco Instruments Co, 847 W. Harrison St, Chicago, Ill, released a portable solder tin content **indicator** for quick analysis of solder quality. . . . Simpson Electric Co, 5218 West Kinzie St, Chicago 44, Ill, has a pocket size **wavemeter** and modulation indicator; range, up to and including 420 Mc; has 2-ft antenna. . . . Acme Electric Welder Co, 2618 Fruitland Road, Los Angeles 11, California, announces a type PT-O air-operated, press type, direct action-projection **welder** with 6-in. throat length and in ratings 20, 30 and 40 kva, single-phase, 220, 440 or 550 v.

Emmert Mfg Co, Waynesboro, Pa, produces a stainless steel **drafting machine** with micromatic quadrant for boards 24 to 132 in. by any length; also has vertical counterbalanced full size **drafting board** units up to 11 ft high by any length. . . . Allied Electrical Mfg. Corp, 1 North LaSalle St, Chicago 2, Ill, introduced the Paige No. 52 non-metallic sheathed **cable connector** for outlet boxes. . . . Lee-Bert Inc, 900 Lapeer St, Saginaw, Mich, has fluted plastic **diffusion shade** in lengths 16 to 40 in., with polished metal strips, clamps on the fluorescent lamp tube.

A modern lighted CLASS ROOM



. . . proved by actual tests
20 FOOTCANDLES AFTER 4½ YEARS
"Hairpinline"
U. S. PAT. PEND.
COLD CATHODE FIXTURES

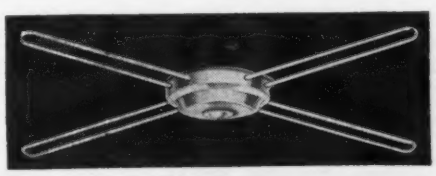
● In the final analysis the proof of any lighting fixture is its performance. It is by this standard that "HAIRPINLINE" Cold Cathode fixtures have proved superior in low surface brightness—in efficiency of lighting—in ultimate economy.

For example: in standard class rooms involving more than 15,000 lamps in 67 installations there was less than 1% replacement over an average period of 2 years.

"HAIRPINLINE" Cold Cathode fixtures are ideal for school lighting as they provide an even distribution of light over the entire class room—practically eliminate all shadows—and with the low lamp brightness require no louvers or glass to shield the lamps. They give approximately 100% light output.

Maintenance is practically nil, but in the event a replacement is necessary, you merely pull out the old lamp and insert a new one. A specially designed bracket facilitates quick—easy replacement.

For complete information we suggest you contact your local distributor.



UX-480 Lightaleer, Jr.—Designed especially for use with the modern cold cathode hairpin lamps and highly successful for class room lighting.

Illuminating Engineering Company
Designers and Manufacturers of Slimline and Cold Cathode Lighting Fixtures
2347 E. NINE MILE ROAD • • • HAZEL PARK, MICHIGAN

NEWS ABOUT PEOPLE

F. L. Witsell Elected V-P, Colorado Public Service

Frederick L. Witsell, director of employee-customer relations department, Public Service Co of Colorado, Denver,

F. L. WITSELL

has been elected a vice-president of that utility.

Mr Witsell formerly was vice-president and general manager of the Pueblo Gas & Fuel Co, a Public Service subsidiary, with which he became identified in 1940. Previously he had been connected with the Toledo Edison Co, and at the time he left to go to Denver he was occupying the position of superintendent of the district heating department.

•

▶ RALPH J. MARTIN of Mt. Vernon, Mo., has been made general manager of the Boone Electric Cooperative Association, Columbia, Mo.

▶ C. HAMILTON MOSES, president of the Arkansas Power & Light Co, Little Rock, has been selected as the South's Man of the Year for 1948 by the editors of *Dixie Business*, published in Atlanta, Ga. The selection was for distinguished service to the South with citation for his Arkansas Plan, which has done so much to help industrialize Arkansas.

▶ DR EDWIN H. COLPITTS, director, Engineering Foundation, New York, was made the recipient of the 1948 Cresson Medal by the Franklin Institute. Dr Colpitts has received the medal for his pioneering achievements leading to the development of practical systems of long distance communication, both by wire and radio. He is the holder of 24 U. S. patents on telephonic inventions, five of which are held jointly with other scientists. The medal was presented to him at traditional Medal Day ceremonies in Philadelphia on October 20.

•

Canadian Electric Group Elects Lawrence Head

George W. Lawrence has been elected president of the Canadian Electrical Manufacturers Association at the recent annual meeting held in Niagara Falls. He is president and general manager of Sangamo Co, Ltd, Leaside, Ont.

Early in his engineering career, Mr Lawrence was connected with the Packard Electric Co, Ltd, St Catharines; Canadian Westinghouse Co, and with Crocker-Wheeler Co (now English Electric Co).

Following his return from overseas with the CEF (First World War), he entered the engineering department of Sangamo Co, Ltd, and held the position of chief engineer, vice-president, and since 1936 president and general manager.

Mr Lawrence has served CEMA in an executive capacity since its inception. At present he is chairman of the special advisory committee on power conservation for the City of Toronto and is a past-chairman of the Toronto branch of the Canadian Manufacturers Association.

•

▶ JUDGE FREDERICK J. DUNN has retired as general council for the New England Electric System, Boston. He joined the then Connecticut River Transmission Co, Worcester, Mass., in 1914 as property attorney. The legal aspects of the System's development have been his chief responsibility for many years. He has also been president of the Gardner Electric Light Co, Northern Berkshire Gas Co, vice-president of the New England Power Co and Green Mountain Power Corp.

▶ CHARLES ODOM, superintendent of distribution for the Bartow, Fla., municipal power system, has been made city manager.

L. A. Scofield Made V-P, Consolidated Edison Units

L. A. Scofield, assistant vice-president of the Consolidated Edison Co of New York, Inc, has been elected vice-president of Westchester Lighting Co and Yonkers Electric Light & Power Co, Consolidated subsidiaries. Mr Scofield will retain his position with Consolidated, handling special assignments.

Consolidated Edison also announced the election of Nils T. Sellman as assistant vice-president. Mr Sellman will

L. A. SCOFIELD

assist Brig Gen Ephraim F. Jeffe, vice-president in charge of sales. The election of Mr Sellman followed his resignation as vice-president of the Westchester and Yonkers companies.

Mr Scofield joined the former New York Edison Co in 1912 as an assistant tester. He transferred to the United Electric Light & Power Co and later became assistant superintendent of distribution engineering for both that company and the New York Edison Company. After the 1936 merger, he was made general superintendent of service inspection and records and then manager of outside plant construction. He was appointed general sales manager in 1945 and became assistant vice-president for sales later the same year. In World War II, Mr Scofield was active in civilian defense activities in New York. As a consultant on the staff of General Brehon Somervell, commanding general of the Army Service Forces, he reorganized that group's industrial personnel division.

Mr Sellman first joined the Consoli-

Let Ryerson Carry the Steel Load

• To the utilities and their equipment manufacturers, Ryerson has meant prompt, efficient steel service for more than a century. Soundly experienced in the handling of every power generator requirement, Ryerson specialists are always ready to work with you on any steel problem, whether it is calculated in pounds or tons.

When your steel needs are varied, one order, one invoice and one shipment from Ryerson does the entire job. Time and money are saved in your purchasing operation. And if your requirements are not readily available from stock, we often are able to supply you with workable alternates.

Today, when great demand is making the job of steel procurement very difficult, our large stocks and long experience can be especially helpful. So contact Ryerson when electrical construction or maintenance calls for steel.

PRINCIPAL PRODUCTS

BARS—Carbon and alloy, hot rolled and cold fin., reinforcing
STRUCTURALS—Channels, angles, beams, etc.
PLATES—Sheared and U. M., Inland 4-Way Floor Plate
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TUBING—Seamless and welded, mechanical and boiler tubes
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MACHINERY & TOOLS—for metal working

RYERSON STEEL

Joseph T. Ryerson & Son, Inc. Plants: New York, Boston, Philadelphia, Detroit, Concinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles, San Francisco.

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...now that

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is plentiful again!

IF you need creosote for pressure-treating wood, just send an SOS to Koppers, and we'll ship your requirements. And you'll look just as happy as the man above, because you'll get the same high-quality Koppers Creosote you've always known.

When you order Koppers Creosote (or Koppers Creosote-Coal Tar Solutions), it's important to remember that you're getting products that have decades of dependable performance behind them . . . that have established enviable records as wood preservatives everywhere.

Send in your order now. And if you want to *play safe*, ask about Koppers yearly contracts that take care of your future needs.

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All Standard Specifications
For All Types of Wood Preservation

KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.

dated Gas Co of New York in 1913, and, after a short connection with the American Gas Association (1921–25), he returned to Consolidated Gas as engineer of utilization. Following the 1936 merger, Mr Sellman was elected assistant vice-president of sales, the position he relinquished in 1944 when he was elected a vice-president of Westchester Lighting and Yonkers Electric Light & Power.

•

Berard Elected President, Ward Leonard Electric

Arthur A. Berard, executive vice-president and general manager of the Ward Leonard Electric Co, Mount Vernon, N. Y., since 1944, has been elected president and general manager. Dawson J. Burns, who resigned as president, has been elected chairman of the executive committee.

Mr Berard joined the company in 1920. He has been a member of the board of directors since 1927 and has served as factory manager and general sales manager.

Mr Burns served as vice-president of the company from 1908 to 1944, when he was elected president. He has been a member of the board of directors since 1903.

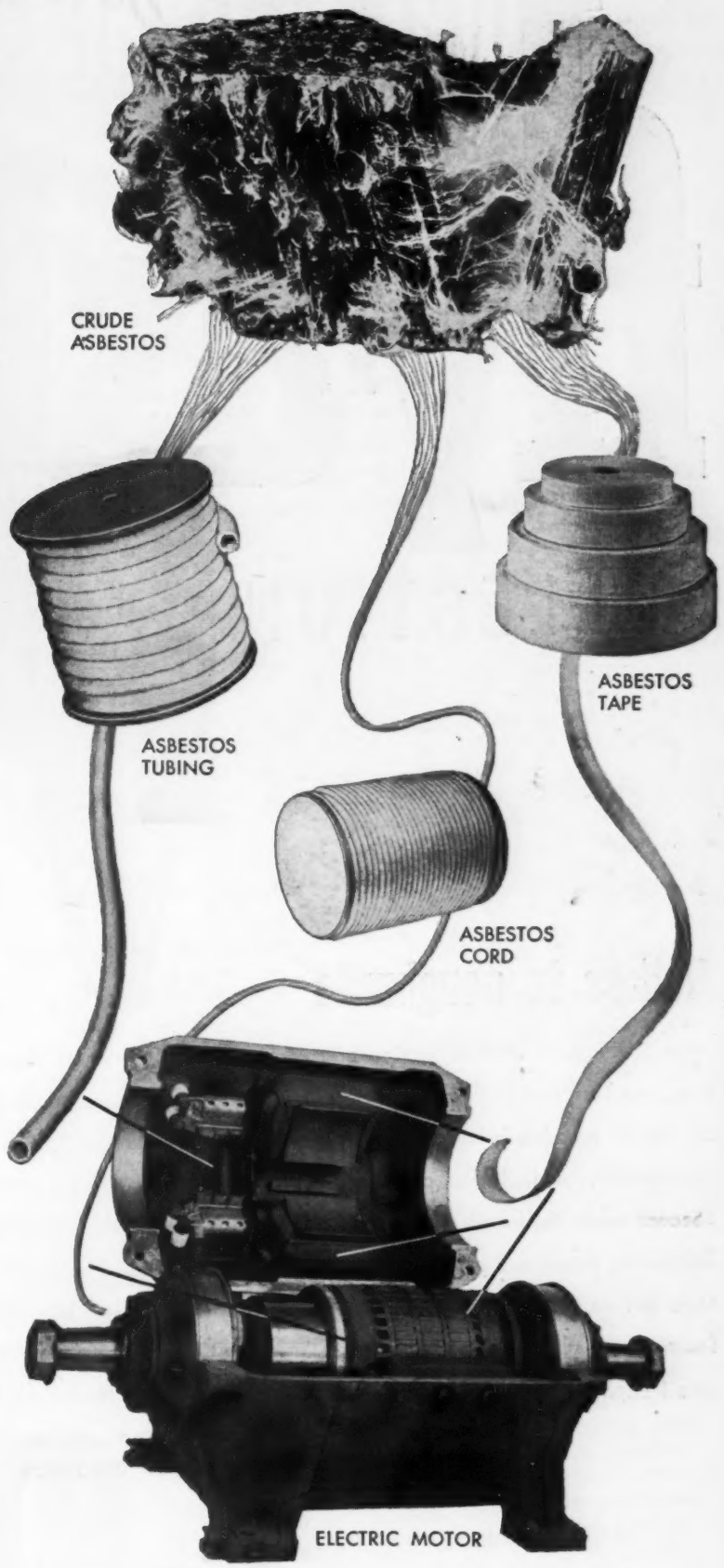
•

▶ CHARLES C. WHITTELSEY, vice-president in charge of construction activities for Ford, Bacon & Davis, engineers-constructors, with offices in New York, Philadelphia, Chicago and Los Angeles, has been elected vice-president in charge of construction activities. He has been connected with the organization since 1925 and was elected a director in 1946. Mr Whittelsey has also been elected executive vice-president of the company's subsidiary, Ford, Bacon & Davis Construction Corp, with headquarters at Monroe, La. He is a member of the American Society of Mechanical Engineers and of other technical societies.

▶ RICHARD L. TEMPLIN, assistant director of research and chief engineer of tests, Aluminum Co of America at New Kensington, Pa., has been elected president of the American Society for Testing Materials for 1948-49. Mr Templin joined the staff of Alcoa as chief engineer of tests in 1919, after spending two years with the National Bureau of Standards in Washington, D. C. Since that time he has had the additional responsibility of assistant director of research, beginning in 1942. Throughout these years he has conceived and designed much of the physical testing equipment used in Alcoa's 21 mechanical testing laboratories. A member of

Protection woven from

The Magic Mineral



In the line of K&M Asbestos Textiles you'll find a complete range of materials to suit the most exacting electrical insulation needs. K&M Asbestos Textiles meet ASTM specifications and are supplied to the electrical industry in the form of Thread, Twisted Cord, Braided Tubing, Woven Tapes, and Cloths.

Request our help on any insulation problem where K&M Asbestos Textiles might be the solution.

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

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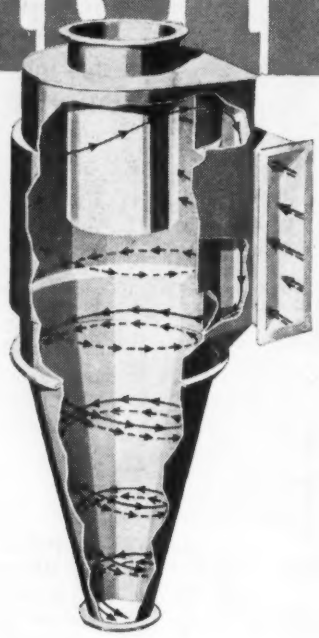
What to do about fly-ash COLLECTION



Dollars to doughnuts

your attitude on dust collection and recovery is "Show me!" Because the Buell van Tongeren high-efficiency cyclone is so different its promise of better service on your job is important. *First*, only the van Tongeren System has the "Shave-off", which is the pay-off in achieving high fractional efficiencies. *Second*, each Buell unit is engineered to the job for which it is to be built. *Third*, size, shape and proportion give it not only a decided efficiency advantage but an assured freedom from plugging which is most important. The facts are marshalled for easy reading in a new 32 page catalog. Write to: **Buell Engineering Company, 70 Pine Street, Suite 4900, New York 5, N. Y.**

buell

Engineered Efficiency in DUST COLLECTION

numerous ASTM, ASME and ASCE committees, Mr Templin is interested in many phases of aluminum activity. He holds a number of patents on aluminum fabrication and testing equipment and is the author of many papers and reports describing work in the non-ferrous and other fields. In 1934, ASTM awarded him the Chas. B. Dudley Medal for his outstanding research on "Fatigue." For many years, and particularly during World War II, Mr Templin has been active in numerous phases of investigational work concerned with the use of aluminum in aircraft and in other vital military applications.

OBITUARY

▶ ARTHUR E. NEWMAN, formerly sales manager of the Bridgeport (Conn.) wire and cable section of the General Electric Co, died at his home in that city on Oct 1. Mr Newman had retired from the company in 1947, after 37 years' continuous service. After holding several positions in service and sales, he was named manager of the company's pole line hardware section in 1930 and two years later became manager of conduit product sales. He subsequently was given added responsibility for Bridgeport wire and cable sales and in 1946 was appointed to the position he held at his retirement.

▶ ARTHUR H. WYMAN, manager of Allis-Chalmers general machinery district sales office at Cleveland, Ohio, since 1925, died on Oct 5 in that city at the age of 65. Mr Wyman had been associated with A-C since his graduation in 1906 from Iowa State College. His affiliations included the Cleveland Engineering Society, the Electrical League of Cleveland and the Association of Iron and Steel Engineers.

▶ HERMAN LARSEN, experimental engineer for the Four Wheel Drive Auto Co, Clintonville, Wis., for the past 28 years, died on Sept 15 in Colorado Springs, Colo. Mr Larsen was one of the oldest employees of the company in point of service. A member of the committee on Winter Driving Hazards of the National Safety Council, Mr Larsen had been active in the research work of that group for the past several years.

▶ I. E. WILSON, 81, for 36 years an electrical engineer with General Electric on power plant construction, died at Somerville, Mass., on Oct 10. A native of Des Moines, Ia., he retired 16 years ago after a career of wide scope.

▶ GEORGE W. JOHNSON, electrical engineer of Seattle, Wash., died in that city on Oct 7. He retired several years ago.

Testing of Meters

(*Continued from page* 91)

on it, using a register-ratio counting machine. Repair cost was materially reduced by removing the old paint from damaged register faces and repainting and stamping them.

Ratios Corrected

The register-ratio check was worthwhile, since 18 cases of incorrect register ratio were found over the property. The register was returned to the SAME meter from which it was removed after being stamped with the company number and a "maximum load." A clean, well-felted glass cover was placed on each meter. Those on which temperature compensation was installed were allowed to "age" 24 hours before testing. Factory or previously compensated meters were then ready for testing.

The tester was equipped with a combination stroboscopic and automatic test board. Each meter was adjusted to absolute accuracy. If, for any reason, a meter could not be adjusted or was difficult to adjust, it was returned to the repair bench. Each was given a "creep" test at approximately 10% over normal voltage. An average of about 70 meters tested per day was possible with this equipment. They were then sealed, and a small sticker reading "Tested and Inspected in Accordance with Texas Laws and Regulations under State Supervision" was put on the glass cover.

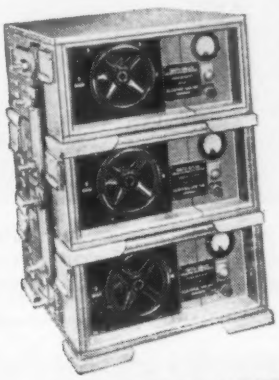
Records Maintained

Each of the above operations was initialed on the repair tag when completed, and, when tested, the lower part of the tag was detached from the meter. The information on it was then transferred to a shop work sheet by the records man. Each of these sheets accommodated 20 meters, listing the tag number, company number, manufacturer number, "as found" test, "as left" test, and the order number on which it was removed. When the meter was reinstalled, the order number on which it was installed was also recorded. This made it possible to trace any meter readily to the old customer or to the new one. Each executed order was also checked against this work sheet before it was sent from the shop. To maintain work at peak efficiency, the foreman helped out on operations that were lagging.

A CINCH at 1800° F.

Preheating and Stress Relieving for Welding —by the Patented Smith-Dolan System

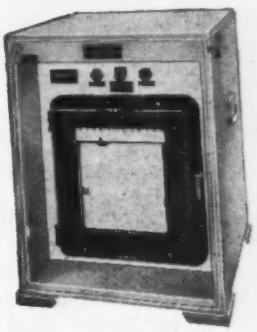
■ It's an accomplished fact that Electric Arc Induction Heaters, through the patented Smith-Dolan System, can generate heat to 1550° F and 850° F on both chrome molybdenum and stainless steel. Here is equipment for ANY TYPE OF JOB—equipment that can be purchased outright or rented. From what other source could you possibly obtain such wide latitude in planning for every job, every problem in preheating and stress relieving before welding?



NEW MODEL U-P, Smith-Dolan System, portable, low frequency induction heater, three-high stack shown, 30 kva, 10 kva per unit.

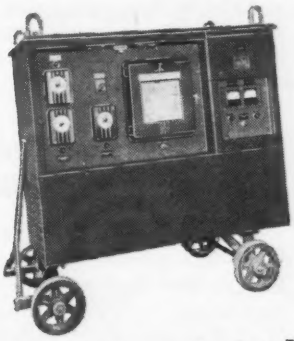
Buy one or stack two or three for increased capacity.

Buy what you need—build as you go.



AUTOMATIC CONTROL CABINET

Used with Model U-P units (shown) and Model GC Duplex 120 or 150 kva induction heaters (shown in catalog).



MODEL BH, Smith-Dolan Induction Heater (mobile type) complete with self contained control instruments.

Electric Arc Induction Heating Equipment can be broken down to manual control, semi-automatic program control and fully automatic heat cycle program control. Operators find this equipment easy to use in field or shop, time saving and guaranteed to produce thorough penetration in heating large and heavy wall weldments. Today, more than ever, Electric Arc equipment is specified where other methods are too costly and impractical. Write for informative catalog.

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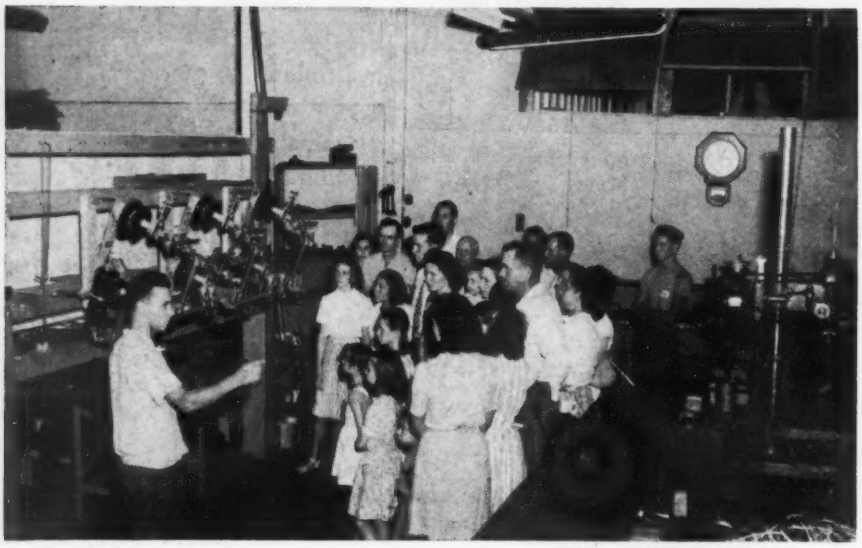


EMPLOYEES of the Southern States Equipment Co, with their families and most of the residents of Hampton, Ga., recently turned out to see town's main manufacturing plant in action. Here an employee describes the action of the repeating cut-outs to a touring group

Western Electric Opens Electronic Devices Plant

Open House for the families of employees and invited friends and neighbors marked the formal opening of the new Western Electric Co plant at Allentown, Pa., last week. Here are manufactured electronic tubes, thermistors, varistors, transistors, and other components of communication and electronic systems. For the precision work provision is made for the control of temperature, humidity, air pressure, sound, and light.

Located on a 50-acre tract, the plant includes four principal buildings, cost over $10,000,000, and employs approximately 2,500 persons.

Main manufacturing building is a two-story steel and brick insulated structure, 450 ft long and 375 ft wide. Over 5,000 machines will eventually be located here. A total of 12 services in pipes are available within 10 ft of any floor location. Atmospheric conditions are controlled throughout the year. Illumination is supplied by more than 13,400 fluorescent tubes supplemented by bench and machine lighting. Reflectors are recessed in an acoustical ceiling. In the production area general illumination is 45 ft-c.

Other buildings include a two-story office building, a utilities building housing four steam boilers, and at a distance a gas generating plant.

Electric power is supplied by Pennsylvania Power & Light Co over two lines at 66 kv to a 10,000 kva substation, then at 13 kv to seven metal-clad load centers for distribution at 120/208 v, 3-phase, 4-wire.

•

Sees Television Receiver Sales of 1,600,000 Units

Predicting a television receiver industry-wide business in 1949 of $330,000,000 at the factory and the sale of approximately 1,600,000 units, Ernest H. Vogel, manager of marketing, electronics department, General Electric Co, stated that if picture tubes can be made available the sale of television sets may even reach 2,000,000.

Speaking at a conference of all General Electric radio and television distributors at Electronics Park in Syracuse, Mr Vogel stated that General Electric is now geared to share heavily in this field.

Walter M. Skillman, manager of sales for the receiver division, estimated that 70% of General Electric's radio-television dollar volume business next year will come from television.

Copper Current-Carrying Capacities Increased

Copper wire of improved annealing characteristics and higher current-carrying ability has been announced by Anaconda Wire & Cable Co in conjunction with comprehensive data compiled by L. F. Hickernell, chief engineer, and his associates, A. A. Jones and C. J. Snyder.

Minute quantities of hardening agents are added to very pure electrolytic copper in the new Anaconda Hy-Therm (AHT). They result in improved annealing characteristics without adversely affecting the conductivity of the wire. As a consequence the Hy-Therm is reported to withstand 24,000 hours at 100C and 1,100 hours at 125C before losing 5% of its initial strength; typical commercial coppers are found to offer only 95 to 200 hours at 100C and 10 to 15 hours at 125C.

Cyclic heating to simulate round-the-clock circuit loading showed that the effect is directly cumulative—triple life for one-third-of-time heating. It should be possible, Hickernell asserts, to design circuits for 110-115C operating limit for AHT conductors as against the customary 75-80C for prevailing conductors. Current-carrying capacities recommended range from 17% to 21% higher than the accepted values for commercial copper.

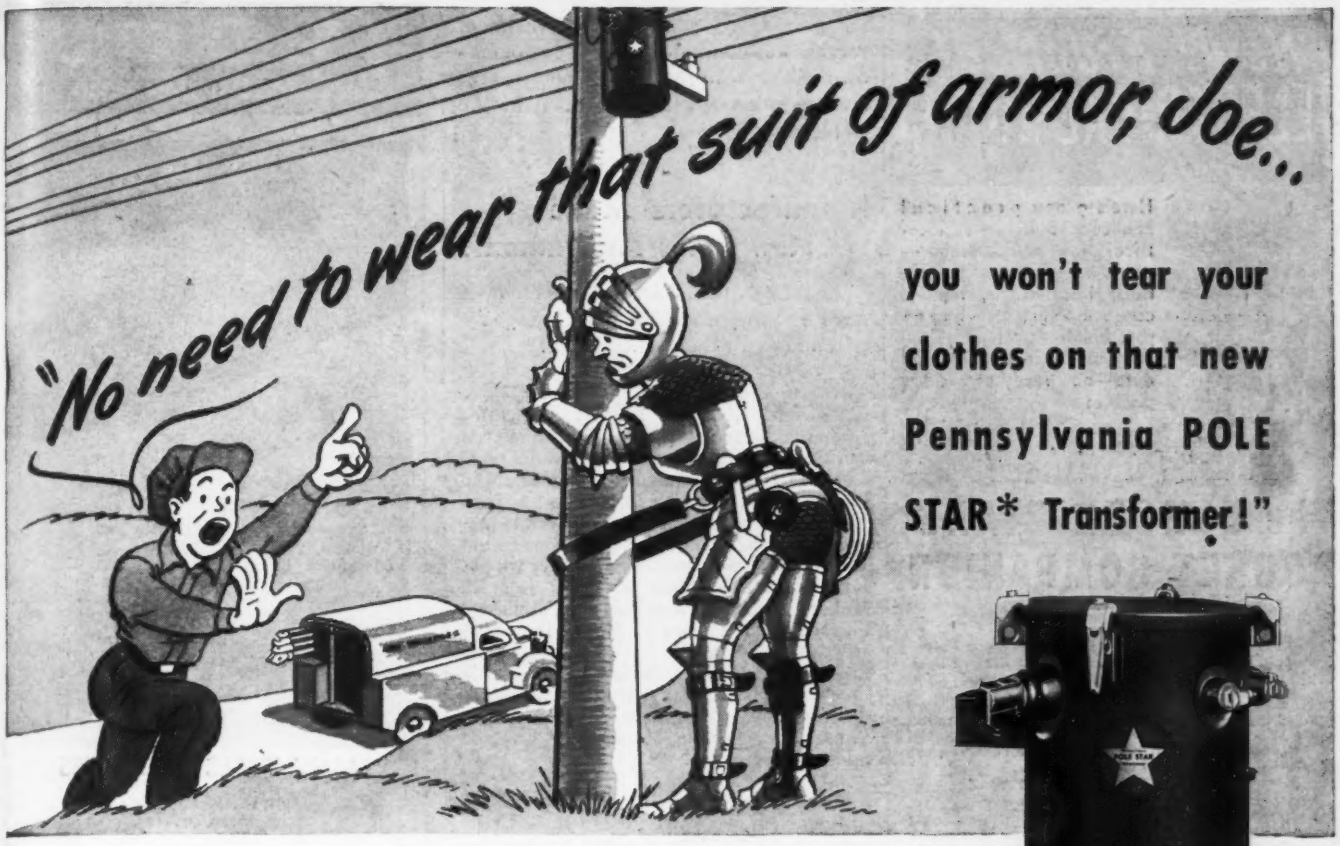
The engineering data made available should enable the distribution engineer to determine with greater accuracy and margin the thermal limits of his present and prospective circuits for particular peak loads, particular ambient temperatures, wind velocities, and fault currents.

•

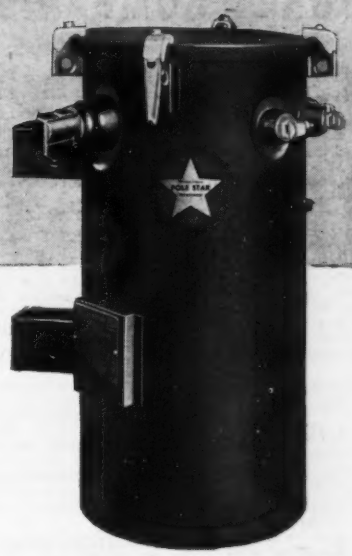
Lincoln Electric Co Sets Up Field Service Shops

Lincoln Electric Co, Cleveland, manufacturer of arc welding equipment, is now authorizing service and repair organizations in all principal industrial centers of the United States to be field service shops for Lincoln equipment.

Each field service shop is sending men to the Cleveland plant for training in repairing and servicing all types of Lincoln welders. These men will also be available for preventive maintenance service. All shops are offering a regu-



you won't tear your clothes on that new Pennsylvania POLE STAR* Transformer!"



Embodying a new wound core design with an inherent low exciting current, POLE STAR Transformers are made in sizes 25 Kva and below, 14400 volts and below, single phase, 60 cycles, OISC, conforming to EEI-NEMA Standards.

Indeed you won't, Joe, not with those streamlined insulating caps on the sidewall-issuing, High Voltage Bushings.

Linemen like these sturdy, well-designed insulating caps because they cover sharp points and edges on bushing terminals that might catch their clothes should they happen to come too close to the bushings.

Insulating caps are attached to the bushings and swing in and out of position on non-corroding, spring wire hinges. Caps are self-supporting above the terminals, leaving the rugged, bronze alloy, solderless connectors completely exposed so the linemen can see the connections they are making.

After connections are made with a standard wrench, the caps are closed by hand pressure which locks them in place to completely cover the bushing terminals.

Making a line connection with a standard wrench.

Cross section of high voltage sidewall bushing with insulating cap.

P.S.

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Of Thrifty
Long And
Experience Reliable

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11. Equipment Troubles
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lar periodic checking and adjustment service to be done in the customer's own plant to prevent serious trouble and maintain efficient operation of the welders.

•

Manufacturers Make New Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

McGraw Electric Co, Toastmaster Products Division, Elgin, Ill., has appointed Joseph E. Nelson sales rpresentative in New York State and northern Pennsylvania territory. Mr Nelson makes his headquarters in Buffalo, N. Y. John L. Donoghue has been made representative in the New York metropolitan area. Among the other recent Toastmaster assignments are Richard V. Jobst, Texas-Oklahoma territory; John E. Mullen, St. Louis; Rowland H. Caugherty, Chicago; and William P. Moore, Denver.

Electrical Manufacturing Co, Battle Creek, Mich., has appointed H. Henry Anthony, 405 Park Square Bldg, 31 St. James Ave., Boston, Mass., New England sales representative.

Federal Telephone & Radio Corp, Clifton, N. J., has appointed Justin J. Callahan to cover the New England territory for its mobile radio division, with headquarters at 43 Leon St, Boston.

Graybar Electric Co has appointed F. F. Jaspersen as Washington (D. C.) manager; H. M. Nazor, Syracuse (N. Y.) manager; L. G. Fields, Richmond manager; C. E. Kirkpatrick, St Louis manager; John Porter, manager at Albany; and R. B. Sayre, Jacksonville manager.

Benbow Manufacturing Co, Redwood City, Calif., has appointed William C. Welde, 1610 North St, Philadelphia, Pa., as a sales agency for the Benbow Trac Troly, an electrical conductor system for cranes, monorails, power tools and other industrial applications.

•

Story of Holophane Issued

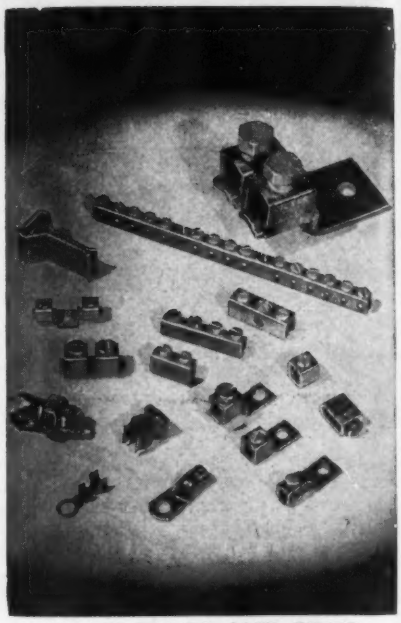
Holophane Co, Inc, New York, has issued, in connection with the celebration of its Golden Jubilee, a booklet entitled "The Story of Holophane." The booklet traces the history of the company from its founding in 1898, discussing, among other things, people and influences out of the past that have done much to shape the company as it is constituted today. Copies of the book are available.

•

Moves Boston Office

Ohio Brass Co, Mansfield, has moved its Boston office from 49 Federal St to 620 Boston Chamber of Commerce Building at 80 Federal St. Lindsay Ellms is the district manager in charge of the office.

ILSCO
Electrical Connectors



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NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Florida—West Florida Electric Co-operative Assn., Graceville, addnl. rural distr. lines, other facilities for exten. rural service to rural communities in West Florida, Holmes Co. **$420,000.**

Georgia—Satilla Rural Electric Membership Co-operative, Alma, 60 mi. rural distr. line, 48 mi. electric transmission line, and sys. imprvs., Bacon Co. **$580,000.**

Ind., West Lafayette—Purdue University, R. B. Stewart, controller, West Lafayette, addns., remodeling Agriculture Chemistry Bldg., $750,000; Smith Hall, $500,000; power and heating plant, $70,000; exten. tunnel sys., paved parking area, $150,000. Plans deposit $20 each.

Ia., Ames—City, City Hall, Sects. 8, 9, and 10, covering conveyors, equipment for 2 substations and incoming steel line structure generator and auxiliary equip. Burns & McDonnell Eng. Co., 95 and Troost Sts., engrs.

La., Ruston—City, City Hall, voted **$425,000** bonds, electric power plant imprvs.

Minnesota—Douglas Co. Co-operative Light & Power Assn., Alexandria, imprv. sys. and rural distr. lines, addnl. rural distr. lines, Douglas Co. **$615,000.**

Minnesota — Todd-Wadena Power & Light Co-operative Assn., Wadena, 178 mi. rural distr. lines and sys. imprvs., Todd Co. **$480,000.**

Minnesota—Border Counties Power Co-operative, Warroad, increased generating capacity and completing previously approved construction, Lake of the Woods Co. **$125,000.**

Minnesota—Tri-County Electric Co-operative, Rushford, imprvs., addns. rural distr. lines, Fillmore, Houston and Winona Counties. **$480,000.**

Missouri—Boone Electric Co-operative, Columbia, 234 mi. rural distr. lines, sys. imprvs., Boone Co. **$820,000.**

Mo., Boonville—State of Missouri, Bd. Training Schools, A. Fleishman, chn., and W. E. Sears, dir., State Office Bldg., Jefferson City, furnishing, del. 2 steam engines, generators, etc. for power plant at Missouri Training School for Boys. Plans deposit $10. Marshall & Brown, 114 W. 10 St., Kansas City, engrs. and archts.

Montana—Sheridan Co. Electric Co-operative, Westby, 610 mi. rural distr. line, and sys. imprvs., Sheridan Co. **$1,088,000.**

N. Y., New York—Bd. Transportation, 250 Hudson St., Zone 13, 239 St. Substation for the White Plains Line, Bronx Boro.

N. C., Cherry Point (Br. New Bern)—Pub. Wks. Office, Bldg. 1005, Marine Barracks, Camp Lejeune, repairing electric generating plant and shop, Bldgs. 90 and 124 at Marine Corps Air Station, Spec. 20861. Plans deposit $10.

O., Parma—Empire Coil Co., 238 Hugunot St., New Rochelle, N. Y., 1 story, 50x80 ft. brick, steel, stone, concrete transmitter house for new Station WXEL. Rene Brugnoni, 515 Madison Ave., New York, N. Y., archt.

Pa., Allentown—Dpt. Property & Supplies, 18 and Herr Sts., Harrisburg, general construction, heating, plumbing, electrical work for E. S. Bldg. for tuberculosis men at Allentown State Hospital. $250,000. Plans deposit $10 each contract. R. Lange & J. E. Everett, 12 N. 6 St., archt. A. F. Jones, c/o owner, ch. engr.

Pa., Hollidaysburg — Dpt. Property & Supplies, 18 and Herr Sts., Harrisburg, admission bldg., **$2,161,608**; power plant, **$439,570**; electrical service and distr., **$113,500**; steam distr. and tunnel, **$132,795**. A. F. Jones, c/o owner, ch. engr.

Texas — Kimble Electric Co-operative, Junction, 418 mi. rural distr. lines and completing previously approved construction, Kimble Co. **$490,000.**

Tex., Laredo—Central Power & Light Co., 120 N. Chaparral St., Corpus Christi, electric power plant, **$500,000.**

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Positive protection against corrosion for lead-sheathed cable

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No elaborate cleaning of cable necessary
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Easy and clean to handle
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Easy to apply in narrow clearances
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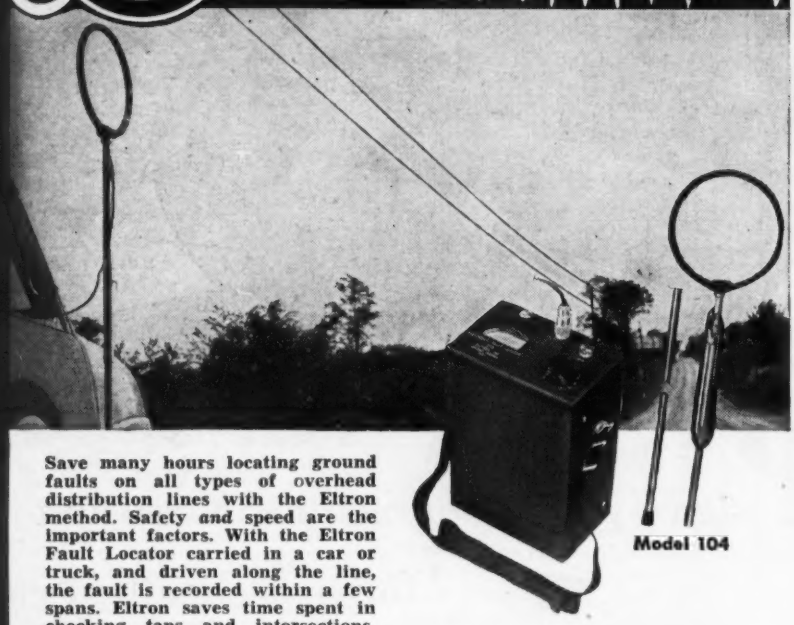
Eltron FAULT LOCATOR



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Save many hours locating ground faults on all types of overhead distribution lines with the Eltron method. Safety *and* speed are the important factors. With the Eltron Fault Locator carried in a car or truck, and driven along the line, the fault is recorded within a few spans. Eltron saves time spent in checking taps and intersections. Locating ground faults can be simple—and fast . . . do you *want proof?* We are glad to demonstrate.

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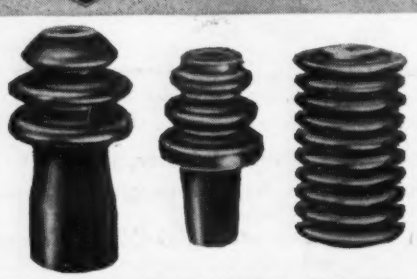

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Washington—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., **furnishing**, installing electric elevators for Grand Coulee Power Plant, at Grand Coulee Dam, approx. 30 mi. northeast of Odair, Spec. 2376.

Low Bidders & Contracts Awarded

California—Pacific Gas & Electric Co., 245 Market St., San Francisco, steam operated electric generating plant with capacity of three 134,000 h.p. generators, near Sando, Contra Costa Co., to Bechtel Corp., 220 Montgomery St., San Francisco. Est. **$50,000,000.**

Fla., Winter Haven—City, imprvt. exten. city owned electric plant recently purchased from Tampa Electric Co. **$300,000.**

Ill., Chicago—Sanitary Dist. of Chicago, 910 S. Michigan Ave., Sept. 2, Lockport Power House, Contr. 47-30 (LPH-E), Lockport, from Monroe Electric Co., 157 W. Ontario St., **$183,964.**

Ind., Argos—Town Bd., municipal power plant addns., imprvs., two 535 kw diesel generators, from Nordberg Mfg. Co., 3073 S. Chase Ave., Milwaukee, Wis., **$135,820.**

Ia., Sioux Center — City, City Hall, power plant and generating equip. $75,000. Buell & Winter, 408 Insurance Exchange Bldg., consult. engrs.

Kan., Iola—City, City Hall, general contract power plant, to Douglas Constr. Co., 510 E. 15 St., Topeka, Approx. **$75,000.**

Neb., Hastings — City, generator and condenser for power imprvs., to Elliott Co., Jeannette, Pa., **$307,200.** Black & Veatch, 4706 Broadway, Kansas City, Mo., engrs.

N. M., Gallup—City, G. Bubany, mayor, steam generating unit, to Stapp Eng. Co., Tabor Bldg., Denver, Colo. **$180,000.** Bids 12/19.

N. C., Winston-Salem—R. J. Reynolds Tobacco Co., Winston-Salem, power plant addn., Patterson Ave. Owner builds. **$106,000.** J. E. Sirrine Co., Greenville, S. C., archt.

Pa., Pittsburgh—Comrs. Allegheny Co., County Bldg., 1 story, 40x80 ft. powerhouse, for Greater Pittsburgh Airport, from Domenico Rea, 27 Woodlawn Ave., **$126,751**; mechanical work, from Wayne Crouse, Inc., 245 Neville St., **$177,876.** Est. $350,000.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Colo., Denver—Save-A-Nickel Stores, L. W. Rettig, owner, 66 S. Logan St., plans by Walter H. Simon, engr. and archt., 1922 E. 18 Ave., shopping center, Colfax Ave. between Krameria and Leyden Sts. **$1,000,000.**

D. C., Wash. — Leon Chatelain, Jr., archt., 1727 K St. N.W., office for Kipplinger's Letters, 1907 K St. N.W. $1,000,000. Beall & LeMay, 1720 M St. N.W., engr.

Miss., Meridian—General Box Co., c/o McNair & Archer, archts., Rosenbaum Bldg., mfg. plant, $600,000.

O., Cincinnati—City, 9 and Plum Sts., municipal airport administration bldg. and hangars, etc. 2 runways, parking areas access roads, etc. **$6,000,000.** Vogt, Ivers & Seaman, 2 Natl. Bank Bldg., consult. engrs. H. H. Kranz, city engr. Benjamin Cook, c/o owner, planning engr.

Tex., Port Neches—B. F. Goodrich Rubber Co., Port Neches, rubber mfg. plant expan. to mfg. cold process rubber, incl. large refrigeration plant. **$1,300,000.**

W. Va., Morgantown — West Virginia University, Morgantown, 5 story, approx. 158x250 ft. biology bldg. $1,500,000. Plans deposit $100. Ticker & Silling, 314 Masonic Bldg., Charleston, archts.

Low Bidders & Contracts Awarded

N. H., Manchester—Manchester Housing Auth., Manchester, housing, Rock Rimmon Site, to Gilbane Bldg. Co., Inc 90 Calverly St., Providence, R. I. **$2,677,311.** Bids 8/24. Awarded 9/28.

Wash., Seattle—U. S. Eng., 4735 E. Marginal Way, Zone 4, general contract 300 bed veterans administration hospital for Veterans Admin., Vermont Ave. between H and I Sts. N.W., Wash. 25, D. C., to Sound Constr. & Eng. Co., 1403 W. 45 St. **$6,077,320.** Bids 9/28.

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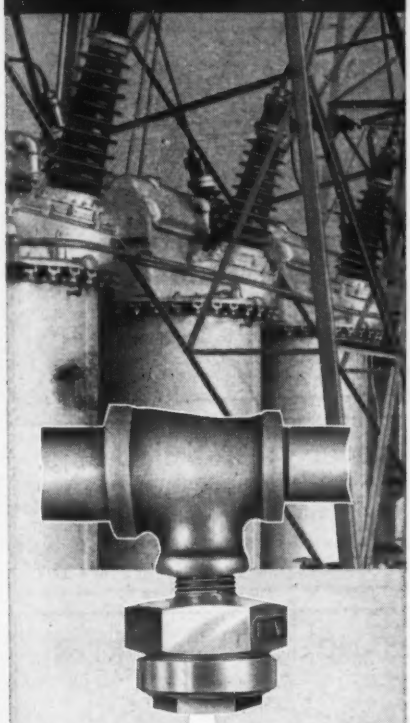
FOG NOZZLES
INSURE AGAINST MORE THAN FIRE ALONE



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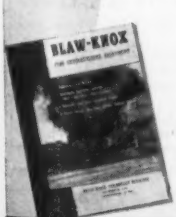

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6. Prevent slippage
7. Retard corrosion
8. Cut maintenance costs

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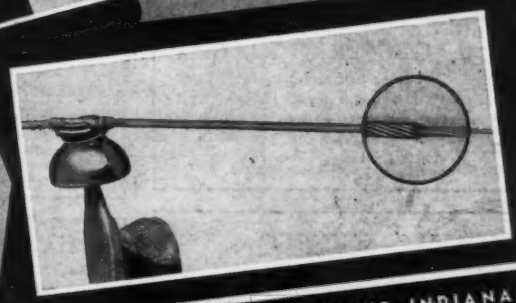
★ *Provide practical, economical, lasting protection*



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RECENT RATE CHANGES

PENNSYLVANIA ELECTRIC CO has filed with the state Public Utility Commission a revision in rates for electric service to its industrial and commercial customers throughout the entire territory of the company. Rates for residential customers are not affected. Three new rates for industrial and commercial service, to replace 28 existing rates, were included in the filing. These are based on customers monthly demands of (1) not more than 10 kw; (2) from 10 to 100 kw; (3) more than 100 kw. The three new rates will provide uniform industrial and commercial rates in all areas served by Penelec. The new rates will increase the cost of electric service to 10,500 industrial and commercial customers and will reflect reductions to 4,200 such customers. Some 21,000 commercial customers will not be affected. The net effect of the filed revision in rates will result in an increase in revenue for Penelec of approximately $900,000 per year, most of which will be derived from fuel clauses included in two of the new rates. These fuel clauses, applicable only to customers using more than 10,000 kwhr of electricity per month, will partly reimburse the company for increased coal costs. While the proposed revision in rates represents an increase of less than 3% of the total operating revenues of Penelec, it is the first rate change to provide additional electric revenue for the company in more than 25 years, during which period many and substantial reductions in electric rates were made.

CONNECTICUT POWER CO, New London, has asked the state Public Utilities Commission to approve a fuel charge averaging 28 cents per month to customers using under 1,000 kwhr each. Customers exceeding 999 kwhr per month already pay fuel charges. The estimated annual increase in electric revenue will be $357,000. The company proposes to give municipalities three months' notice before applying the fuel charge to street lighting service at the start of the municipal fiscal year.

ABINGTON ELECTRIC CO, Clarks Summit, Pa., has filed a tariff supplement with the state Public Utility Commission to reduce rates, effective Nov 15. Under the proposed tariff, a total of 4,342 of Abington's 4,655 customers in Wyoming and Lackawanna counties would have their bills trimmed $7,778 a year. The greatest number to benefit would be residential service users.

BELTON (S. C.) LIGHT & POWER CO has been granted a fuel adjustment clause by the state Public Service Commission, resulting in a slight rate increase. The Belton utility buys power from the Duke Power Co and resells it. In seeking the adjustment, the company simply intended to pass on to its customers the additional cost that had been previously imposed upon it when Duke Power received permission for a fuel adjustment clause.

EAST POINT, GA., City Council has increased the city's light and water rates to the customers served by the municipal utility plant. It is estimated that an additional $8,000 net per month will go into the city treasury through the action. Light rates were increased approximately 50 cents per meter and water rate approximately 67 cents per meter.

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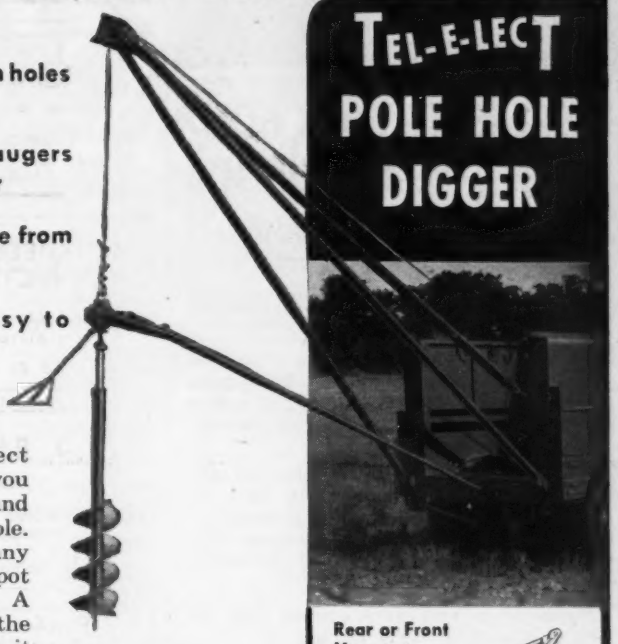

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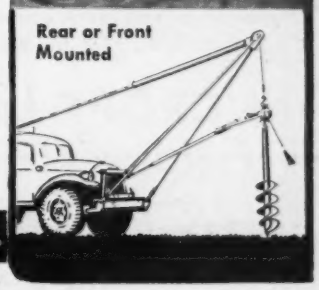

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LETTERS TO THE EDITOR

Cost of McNary Dam

To the Editor of ELECTRICAL WORLD:

I was greatly interested in the extremely well prepared and informative article *One Less River to Boss*, which appeared in the August 14th issue of ELECTRICAL WORLD. The development of the Wisconsin River has been carried forward with wise foresight and a most commendable regard for economy.

In discussing the McNary Dam on the Columbia River, the article stated that the estimated cost is $594,000,000 and used this estimate in making comparisons and drawing a conclusion concerning the cost of future river development programs. The writer of the article has obviously received quite erroneous information regarding the McNary costs. I believe you will be interested in knowing that our latest estimates for this project, with an installed generating capacity of 980,000 kw, show that the project will cost approximately $227,000,000 at current cost indices.

Theron D. Weaver
Colonel, Corps of Engineers
Division Engineer

Editor's Note: After considerable checking, of both Col. Weaver's figure for McNary Dam and the figure published in ELECTRICAL WORLD, Aug. 14, it becomes apparent that Col. Weaver's figure is correct. This being so, the McNary project would constitute about 28% of the total so far invested in TVA, not 74%, as published. Despite the great disparity between the figures, we think the point remains valid—that vast sums of money remain to be invested—and doubtless will be invested—in U. S. river development. Any study of existing federal plans for river development indicate that the sum remaining to be spent will more than match what's already been spent for river development by the United States.

•

Utility's Kings River Plan Backed

A preliminary staff counsel recommendation to the Federal Power Commission on pending applications for development of the Kings River in central California has favored the Pacific Gas & Electric Co, providing the utility agrees to compensate irrigationists for interference with their operations. The Bureau of Reclamation and the Fresno Irrigation District also are seeking permission to develop the north fork and main channel of the river, site of the proposed PG&E project.

LIGHTING ENGINEER

Must be a graduate electrical engineer, age 27 to 35, with several years experience in lamps, fixtures or lighting application. Experience in design, sales, writing or speaking also desirable but not essential. This is an interesting position for a young engineer who likes variety and is interested in providing engineering services and sales promotion aid to the sales department. This vacancy is in the commercial engineering department of an established New England electrical manufacturer. State briefly your qualifications, salary requirements and availability.

P-6827, Electrical World
330 West 42nd Street, New York 18, N. Y.

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CHIEF ENGINEER—Power Station—To take charge of 100,000 kw 1250 lb. steam turbine station now being constructed in Middle west area—Should have experience with operation and maintenance 1200 lb. high temperature power station equipment, also experience successfully directing station operating organization. References required. P-6374, Electrical World.

ASSISTANT SUPERVISOR—Power Station—Should be at least 30 years old and have technical education—Also experience with operation and maintenance high-pressure, high-temperature power station equipment. Location Central Illinois. P-6375, Electrical World.

WANTED—A Foreman for electrical motor repair and rewinding shop, capable of supervising 30 employees. Must be capable of doing some designing. Most of work is for paper mills and woodworking industries. Qualified man would have privilege of becoming stock owner, if he desires. Located in Wisconsin. P-6712, Electrical world.

WANTED: ELECTRICAL Engineer with experience in the design, construction and operation of 69 KV substations and transmission lines. Furnish detailed application showing experience record, qualifications and references. Minnkota Power Cooperative, Inc., Grand Forks, North Dakota.

ENGINEERS: LARGE college offers $3000, approx. half time teaching-studying. All ranks univ. positions, experienced $4500-$6500 nine months. Give phone, photo, qualifications. Cline Teachers Agency, East Lansing, Mich.

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WANTED—An electrical engineer with or without sales experience, to sell electrical wiring supplies and apparatus to industries such as paper mills and woodworking plants. SW-6711, Electrical World.

SALES ENGINEER—Machinery sales organization operating on West Coast South America has opening for competent electrical engineer for sales of electrical apparatus. Must be graduate engineer preferably General Electric or Westinghouse test course, Spanish an asset but not essential. Advise age, experience, marital status. SW-6804, Electrical World.